



# **Fire Engineering Brief**

## **Galleria Shopping Centre**

### **Redevelopment**

**284 Collier Road,  
Morley WA 6062**

Client: Vicinity Centres

Project No: 240380

Document No: 240380\_FEB, Rev. F

Report Date: 22.08.2025



## Document Control Record

|              |                                                                                   |
|--------------|-----------------------------------------------------------------------------------|
| Prepared by: | Amy Chao                                                                          |
| Position:    | Senior Fire Safety Engineer                                                       |
| Signed:      |  |

|              |                                                                                     |
|--------------|-------------------------------------------------------------------------------------|
| Approved by: | Alex Alexandrovski                                                                  |
| Position:    | Senior Fire Safety Engineer                                                         |
| Signed:      |  |

### REVISION STATUS

| Revision | Description of Revision          | Date       | Approved |
|----------|----------------------------------|------------|----------|
| A        | Issued for stakeholders review   | 17.04.2025 | AA       |
| B        | Issued to DFES                   | 29.04.2025 | AA       |
| C        | Issued for tender                | 28.05.2025 | AA       |
| D        | Issued for tender                | 6.06.2025  | AA       |
| E        | Issued for review by design team | 11.08.2025 | AA       |
| F        | Issued for review to DFES        | 22.08.2025 | AA       |

Recipients are responsible for eliminating all superseded documents in their possession.

BCA Consultants (WA) Pty Ltd  
ACN: 165 448 493

Suite 59, City West Centre  
102 Railway Parade  
WEST PERTH WA 6005

PO Box 1139,  
West Perth WA 6872

Telephone: +61 8 9265 1400  
Facsimile: +61 8 9321 9755  
Internet: [www.bcagroup.com.au](http://www.bcagroup.com.au)



## Executive Summary

This Fire Engineering Brief (FEB) presents a fire safety engineering strategy proposed to be adopted for the analysis of the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume One, Building Code of Australia 2022 [ABCB, 2022] associated with the redevelopment of the Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062.

The Galleria Shopping Centre (GSC) is being redeveloped in stages. The scope of this stage of redevelopment includes the centre and north part of the Ground Floor and First Floor (Myer Mall).

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a “performance-based building design”. The deviations from the BCA DtS provisions that require assessment, as identified by the building surveyor for the project, are identified in Table 1.

| Perf. Sol. | Performance Solutions                                                                                                                                                                                                                                                                                      | DtS Provisions                                                 | Performance Requirements |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------|
| 1          | The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120                                                                                                                                                                                                            | C2D2(2) and Table S5C21e                                       | C1P1                     |
|            | The loadbearing columns that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--                                                                                                                                                                                                   | C2D2(2) and Table S5C21g                                       |                          |
| 2          | MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 are either not located in fire-rated enclosures or are located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building                                                        | C3D14(2)(a)                                                    | C1P2(1)(d); EP2.2        |
|            | Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped                                                                                                                                                      | C4D15(2)                                                       | C1P2(1)(d)               |
|            | Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated and is not enclosed in plant rooms that have FRL not less than --/120/120.                                                                                                                                | E2D15(2)(a), Cl. S21C7(7) of Spec. 21, Cl. 4.10.2.2(a) AS 1668 | E2P2                     |
| 3          | Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered car parks or into open spaces from where occupants need to travel either via covered car parks or under a roofed area in lieu of directly to a road or open space | D2D5(3)(a)                                                     | D1P4; E2P2               |
| 4          | Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m                                                                                                                                                                                                    | D2D5(3)(a)                                                     | D1P4; E2P2               |
|            | Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m                                                                                                                                                                                     |                                                                |                          |
|            | Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m                                                                                                                                                   |                                                                |                          |

| Perf. Sol. | Performance Solutions                                                                                                                                                                                                                                                                                                                                                                                                                               | DtS Provisions                               | Performance Requirements |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------------|
|            | Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m                                                                                                                                                                                                                                                                                                                                 |                                              |                          |
|            | Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m                                                                                                                                                                                                                                                                                                                                                     |                                              |                          |
|            | Travel distances from the GF BoH area to the nearest of the alternative exits are extended up to 50 m                                                                                                                                                                                                                                                                                                                                               |                                              |                          |
| 5          | Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m                                                                                                                                                                                                                                                                                    | D2D5(3)(a)                                   | D1P4, E2P2               |
|            | Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m                                                                                                                                                                                                                                                           | D2D6(c)(iii)                                 |                          |
|            | Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions                                                                                                                                                                                                                                                                                                                                         | E2D15(2)(a), Cl. S21C2(2) of Spec. 21        | E2P2                     |
|            | Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m                                                                                                                                                                                                                                                                                                                                              | E2D15(2)(a), Cl. S21C4(2) of Spec. 21        |                          |
|            | Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m                                                                                                                                                                                                                                                                                                                                                          |                                              |                          |
|            | Make-up air velocity through vertical openings exceeds 1 m/s                                                                                                                                                                                                                                                                                                                                                                                        | E2D15(2)(a), Cl. S21C6(3) of Spec. 21        |                          |
| 6          | The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03)                                                                                                                                                                                                                                                                                                      | D2D12(1)                                     | D1P5, E2P2               |
| 7          | First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space                                                                                                                                                                                                                                                                                                                      | D2D12(2)(a)                                  | D1P5, E2P2               |
|            | Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space | D2D12(2)(b)                                  |                          |
| 8          | Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m                                                                                                                                                                                                                        | E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021 | E1P3                     |

| Perf. Sol. | Performance Solutions                                                                                                                                                                                                                     | DtS Provisions                                                                             | Performance Requirements |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------|
|            | Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m | E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021                                               |                          |
|            | Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m                                                       | E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021                                                 |                          |
|            | Internal fire hydrants are not located in every fire-isolated exit                                                                                                                                                                        | E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021                                             |                          |
|            | Internal fire hydrants installed in retail malls are provided more than 4 m from required exits                                                                                                                                           | E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021                                                 |                          |
| 9          | In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels                                                        | E1D3(2)(a)                                                                                 | E1P1                     |
| 10         | Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy       | Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)                              | E1P4                     |
| 11         | The eastern canopies in the North Laneway are protected with vertical sidewall sprinklers on a performance basis.                                                                                                                         | E1D4(b), Cl. S17C2(a) of Spec. 17 and Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017 | E1P4                     |
| 12         | Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread                                                                                                      | S17C3(a) of Spec. 5 and E1D4(b)                                                            | C1P2(1)(d), E1P4         |
| 13         | After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s                                                                                        | S21C6(2) of Spec. 21 and E2D15(2)(a)                                                       | E2P2                     |
| 14         | The existing smoke exhaust fans located in the Myer retail mall and Plaza generate noise levels up to 90 dB in lieu of a maximum noise level of 80 dB                                                                                     | Cl. 4.6 of AS 1668.1                                                                       | E2P2                     |

*Table 1: Performance Solutions and relevant BCA provisions*

The assessment was carried out in accordance with the process prescribed by BCA Clause A2G2(4) and endorsed by the Government of Western Australia, Department of Mines, Industry Regulations and Safety (DMIRS).

The fire engineering analysis of the performance-based design generally follows the methodology outlined in the Australian Fire Engineering Guidelines [ABCB, 2021], which is produced by the Australian Building Codes Board.

# Table of Contents

|                                                                                            |    |
|--------------------------------------------------------------------------------------------|----|
| 1. Introduction.....                                                                       | 13 |
| 2. Objectives.....                                                                         | 14 |
| 2.1 Legislative objectives.....                                                            | 14 |
| 2.2 Design objectives.....                                                                 | 14 |
| 3. Assumptions & Limitations.....                                                          | 15 |
| 4. Principal Building Characteristics.....                                                 | 16 |
| 4.1 General.....                                                                           | 16 |
| 4.2 Area of Works.....                                                                     | 17 |
| 4.3 Fire Compartment.....                                                                  | 18 |
| 4.4 Smoke Zones.....                                                                       | 19 |
| 4.5 Department of Fire & Emergency Services Access.....                                    | 22 |
| 4.6 Egress Provisions.....                                                                 | 23 |
| 4.7 Preventive and Protective Measures.....                                                | 23 |
| 4.8 Hazards.....                                                                           | 25 |
| 4.9 Occupant Characteristics.....                                                          | 26 |
| 4.9.1 Occupant Groups.....                                                                 | 26 |
| 4.9.1 Number of Occupants.....                                                             | 26 |
| 5. Assessment Data.....                                                                    | 28 |
| 6. Relevant Stakeholders.....                                                              | 32 |
| 7. Fire Engineering Brief Process.....                                                     | 33 |
| 8. Summary of Performance Solutions and Relevant BCA Criteria.....                         | 34 |
| 9. Fire Safety Strategy.....                                                               | 38 |
| 9.1 General.....                                                                           | 38 |
| 9.2 Fire Resistance and Stability, Compartmentation and Separation, Protection of Openings | 38 |
| 9.3 Provisions for Escape, Construction of Exits.....                                      | 42 |
| 9.4 Fire Fighting Equipment.....                                                           | 45 |
| 9.5 Smoke Hazard Management.....                                                           | 51 |
| 9.6 Smoke Exhaust in Mini-major Tenancies.....                                             | 52 |
| 9.7 Smoke Exhaust in Retail Malls.....                                                     | 53 |
| 9.8 Make-up Air Provisions.....                                                            | 54 |
| 9.9 Emergency Lighting, Exit Signs.....                                                    | 56 |
| 9.10 Fire Safety Signage.....                                                              | 62 |

|        |                                                                                   |    |
|--------|-----------------------------------------------------------------------------------|----|
| 9.11   | Building Subject to FSER Notice .....                                             | 63 |
| 9.12   | Maintenance.....                                                                  | 63 |
| 10.    | Quantitative Engineering Tools and Parameters.....                                | 64 |
| 10.1   | Required Safe Egress Time versus Available Safe Egress Time Concept.....          | 64 |
| 10.2   | Required Safe Egress Time (RSET) Modelling.....                                   | 64 |
| 10.2.1 | Cue Times ( $t_d$ ).....                                                          | 65 |
| 10.2.2 | Response Time ( $t_{pm}$ ).....                                                   | 67 |
| 10.2.3 | Occupant Egress Time ( $t_e$ ).....                                               | 68 |
| 10.2.4 | Safety Factors .....                                                              | 70 |
| 10.3   | Available Safe Egress Time (ASET) Modelling & FDS Input Parameters .....          | 70 |
| 10.3.1 | Mesh Size.....                                                                    | 70 |
| 10.3.2 | Fire Reaction Parameters .....                                                    | 71 |
| 10.3.3 | Heat Release Rate per Unit Area.....                                              | 71 |
| 10.4   | Occupant Evacuation Limiting Criteria.....                                        | 72 |
| 10.4.1 | Visibility and Temperature Limits .....                                           | 72 |
| 10.4.2 | Availability of Exits .....                                                       | 72 |
| 10.4.3 | Summary .....                                                                     | 72 |
| 10.4.4 | Fire Brigade Intervention Limiting Criteria .....                                 | 73 |
| 10.5   | Design Fires .....                                                                | 73 |
| 10.5.1 | Fire Growth Rates.....                                                            | 74 |
| 10.5.2 | Fire Size .....                                                                   | 75 |
| 11.    | Performance Solution No. 1 – Performance-based FRL of Loadbearing Structure ..... | 79 |
| 11.1   | Relevant BCA DtS Provisions.....                                                  | 79 |
| 11.2   | Performance Solution.....                                                         | 79 |
| 11.3   | Relevant Performance Requirements.....                                            | 80 |
| 11.4   | Assessment Method.....                                                            | 80 |
| 11.5   | Intent of the BCA.....                                                            | 80 |
| 11.6   | Assessment Methodology .....                                                      | 80 |
| 11.7   | Comparative Characteristics .....                                                 | 82 |
| 11.8   | Acceptance Criteria .....                                                         | 83 |
| 11.9   | Fire Scenarios Selection.....                                                     | 83 |
| 11.9.1 | Fire Extinguished by Occupants .....                                              | 83 |
| 11.9.2 | Fire Extinguished or Controlled as a Result of Sprinkler Activation .....         | 84 |
| 11.9.3 | Sprinkler Performance .....                                                       | 84 |
| 11.9.4 | Sprinkler Performance .....                                                       | 84 |

|       |                                                                                                                        |     |
|-------|------------------------------------------------------------------------------------------------------------------------|-----|
| 11.10 | Equivalent Fire Severity (Burnout) Assessment Basis .....                                                              | 85  |
| 12.   | Performance Solution No. 2 – Non-fire-rated Plant Rooms and Cabling to AHUs.....                                       | 88  |
| 12.1  | Relevant BCA DtS Provisions.....                                                                                       | 88  |
| 12.2  | Performance Solution.....                                                                                              | 89  |
| 12.3  | Relevant Performance Requirements.....                                                                                 | 90  |
| 12.4  | Assessment Method.....                                                                                                 | 90  |
| 12.5  | Intent of the BCA.....                                                                                                 | 90  |
| 12.6  | Assessment Methodology .....                                                                                           | 90  |
| 12.7  | Acceptance Criteria .....                                                                                              | 91  |
| 13.   | Performance Solution No. 3 – Performance-based Non-fire-isolated Exits .....                                           | 92  |
| 13.1  | Relevant BCA DtS Provisions.....                                                                                       | 92  |
| 13.2  | Performance Solution.....                                                                                              | 92  |
| 13.3  | Relevant Performance Requirements.....                                                                                 | 93  |
| 13.4  | Assessment Method.....                                                                                                 | 93  |
| 13.5  | Intent of the BCA.....                                                                                                 | 93  |
| 13.6  | Assessment Methodology .....                                                                                           | 94  |
| 13.7  | Acceptance Criteria .....                                                                                              | 94  |
| 14.   | Performance Solution No. 4 – Extended Travel Distances from Areas not Provided with Automatic Smoke Exhaust.....       | 95  |
| 14.1  | Relevant BCA DtS Provisions.....                                                                                       | 95  |
| 14.2  | Performance Solution.....                                                                                              | 95  |
| 14.3  | Relevant Performance Requirements.....                                                                                 | 95  |
| 14.4  | Assessment Method.....                                                                                                 | 95  |
| 14.5  | Intent of the BCA.....                                                                                                 | 95  |
| 14.6  | Assessment Methodology .....                                                                                           | 96  |
| 14.7  | Comparative Characteristics .....                                                                                      | 97  |
| 14.8  | Acceptance Criteria .....                                                                                              | 97  |
| 14.9  | Fire Scenarios .....                                                                                                   | 97  |
| 15.   | Performance Solution No. 5 – Performance-based Egress and Smoke Hazard Management Provisions in the Retail Malls ..... | 99  |
| 15.1  | Relevant BCA DtS Provisions.....                                                                                       | 99  |
| 15.2  | Performance Solution.....                                                                                              | 99  |
| 15.3  | Relevant Performance Requirements.....                                                                                 | 102 |
| 15.4  | Assessment Method.....                                                                                                 | 102 |
| 15.5  | Intent of the BCA.....                                                                                                 | 102 |

|      |                                                                                      |     |
|------|--------------------------------------------------------------------------------------|-----|
| 15.6 | Assessment Methodology .....                                                         | 103 |
| 15.7 | Acceptance Criteria .....                                                            | 104 |
| 15.8 | Fire Scenarios Selection.....                                                        | 104 |
| 16.  | Performance Solution No. 6 – Performance-based Access to Fire-Isolated Corridor 03 . | 106 |
| 16.1 | Relevant BCA DtS Provisions.....                                                     | 106 |
| 16.2 | Performance Solution .....                                                           | 106 |
| 16.3 | Relevant Performance Requirements.....                                               | 106 |
| 16.4 | Assessment Method.....                                                               | 106 |
| 16.5 | Intent of the BCA.....                                                               | 107 |
| 16.6 | Assessment Methodology .....                                                         | 108 |
| 16.7 | Acceptance Criteria .....                                                            | 108 |
| 17.  | Performance Solution No. 7 – Performance-based Discharge from Fire-Isolated Exits... | 110 |
| 17.1 | Relevant BCA DtS Provisions.....                                                     | 110 |
| 17.2 | Performance Solution .....                                                           | 110 |
| 17.3 | Relevant Performance Requirements.....                                               | 111 |
| 17.4 | Assessment Method.....                                                               | 111 |
| 17.5 | Intent of the BCA.....                                                               | 112 |
| 17.6 | Assessment Methodology .....                                                         | 112 |
| 17.7 | Acceptance Criteria .....                                                            | 113 |
| 18.  | Performance Solution No. 8 – Performance-based Fire Hydrant System .....             | 114 |
| 18.1 | Relevant BCA DtS Provisions.....                                                     | 114 |
| 18.2 | Performance Solution .....                                                           | 115 |
| 18.3 | Relevant Performance Requirements.....                                               | 115 |
| 18.4 | Assessment Method.....                                                               | 115 |
| 18.5 | Intent of the BCA.....                                                               | 115 |
| 18.6 | Assessment Methodology .....                                                         | 116 |
| 18.7 | Acceptance Criteria .....                                                            | 116 |
| 19.  | Performance Solution No. 9 – Performance-based Attack on Fire by Building Occupants  | 118 |
| 19.1 | Relevant BCA DtS Provisions.....                                                     | 118 |
| 19.2 | Performance Solution .....                                                           | 118 |
| 19.3 | Relevant Performance Requirements.....                                               | 118 |
| 19.4 | Assessment Method.....                                                               | 118 |
| 19.5 | Intent of the BCA.....                                                               | 119 |
| 19.6 | Assessment Methodology .....                                                         | 120 |



|        |                                                                                                                |     |
|--------|----------------------------------------------------------------------------------------------------------------|-----|
| 19.7   | Acceptance Criteria .....                                                                                      | 120 |
| 20.    | Performance Solution No. 10 – Omission of Sprinklers from Skylights and External Covered Area 121              |     |
| 20.1   | Relevant BCA DtS Provisions.....                                                                               | 121 |
| 20.2   | Performance Solution.....                                                                                      | 121 |
| 20.3   | Relevant Performance Requirements.....                                                                         | 122 |
| 20.4   | Assessment Method.....                                                                                         | 122 |
| 20.5   | Intent of the BCA.....                                                                                         | 122 |
| 20.6   | Assessment Methodology .....                                                                                   | 123 |
| 20.7   | Acceptance Criteria .....                                                                                      | 123 |
| 21.    | Performance Solution No. 11 – Performance-based Fire Sprinkler System in North Laneway 125                     |     |
| 21.1   | Relevant BCA DtS Provisions.....                                                                               | 125 |
| 21.2   | Performance Solution.....                                                                                      | 125 |
| 21.3   | Relevant Performance Requirements.....                                                                         | 126 |
| 21.4   | Assessment Method.....                                                                                         | 126 |
| 21.5   | Intent of the BCA.....                                                                                         | 127 |
| 21.6   | Assessment Methodology .....                                                                                   | 127 |
| 21.7   | Acceptance Criteria .....                                                                                      | 127 |
| 22.    | Performance Solution No. 12 – Performance-based Separation between Sprinklered and Non-sprinklered Parts ..... | 128 |
| 22.1   | Relevant BCA DtS Provisions.....                                                                               | 128 |
| 22.2   | Performance Solution.....                                                                                      | 128 |
| 22.3   | Relevant Performance Requirements.....                                                                         | 129 |
| 22.4   | Assessment Method.....                                                                                         | 129 |
| 22.5   | Intent of the BCA.....                                                                                         | 129 |
| 22.6   | Assessment Methodology .....                                                                                   | 129 |
| 22.7   | Acceptance Criteria .....                                                                                      | 130 |
| 22.8   | Radiant Heat Flux Assessment Input Parameters .....                                                            | 131 |
| 22.8.1 | Fire Scenario Selection.....                                                                                   | 131 |
| 23.    | Performance Solution No. 13 – Performance-based Increased Air Velocity through Make-up Air Openings.....       | 134 |
| 23.1   | Relevant BCA DtS Provisions.....                                                                               | 134 |
| 23.2   | Performance Solution.....                                                                                      | 134 |
| 23.3   | Relevant Performance Requirements.....                                                                         | 134 |
| 23.4   | Assessment Method.....                                                                                         | 134 |

|      |                                                                                                            |     |
|------|------------------------------------------------------------------------------------------------------------|-----|
| 23.5 | Intent of the BCA.....                                                                                     | 134 |
| 23.6 | Assessment Methodology .....                                                                               | 135 |
| 23.7 | Acceptance Criteria .....                                                                                  | 135 |
| 24.  | Performance Solution No. 14 – Performance-based Increased Noise Levels of Existing Smoke Exhaust Fans..... | 136 |
| 24.1 | Relevant BCA DtS Provisions.....                                                                           | 136 |
| 24.2 | Performance Solution.....                                                                                  | 136 |
| 24.3 | Relevant Performance Requirements.....                                                                     | 136 |
| 24.4 | Assessment Method.....                                                                                     | 136 |
| 24.5 | Intent of the BCA.....                                                                                     | 136 |
| 24.6 | Assessment Methodology .....                                                                               | 137 |
| 24.7 | Acceptance Criteria .....                                                                                  | 137 |
| 25.  | References.....                                                                                            | 138 |
| 26.  | Appendix A – Assumptions and Limitations .....                                                             | 140 |
| 27.  | Appendix B – DFES FEB Meeting Minutes.....                                                                 | 143 |
| 28.  | Appendix C – Fire Rated Corridors.....                                                                     | 150 |
| 29.  | Appendix D – Fire Hydrant Coverage Plans .....                                                             | 153 |
| 30.  | Appendix E – Smoke Zones .....                                                                             | 156 |
| 31.  | Appendix F – DFES FEB Meeting No. 2 Minutes.....                                                           | 159 |

## 1. Introduction

This Fire Engineering Brief (FEB) presents a fire safety engineering strategy proposed to be adopted for the analysis of the identified deviations from the Deemed-to-Satisfy (DtS) provisions of the National Construction Code Volume One, Building Code of Australia 2022 [ABCB, 2022] associated with the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062.

The method of meeting the Performance Requirements of the BCA adopted for this project is in accordance with BCA Clause A2G1(2)(c), i.e. compliance with the Performance Requirements is achieved by a combination of a “*Performance Solution*” and “*Deemed-to-Satisfy Solution*”.

The works do not comply in full with the BCA DtS provisions; therefore, the design is considered a “performance-based building design”. The deviations from the BCA DtS provisions that require assessment in accordance with BCA Clause A2G2(1), as identified by the building surveyor for the project (BCA Consultants), are detailed in Section 8.

The purpose of this document is to identify the deviations from the BCA DtS provisions; outline the proposed Performance Solutions, acceptance and limiting criteria, design concepts, and fire safety strategy; and generally set down the fire safety engineering philosophy for the approval by the design team. This report is limited to only assessing the deviations from the BCA DtS provisions detailed in Section 8.

BCA Consultants (WA) Pty Ltd (BCA Consultants) developed this report at the request of Vicinity Centres Pty Ltd, who are the owner for the site.

## **2. Objectives**

The fire safety objectives must satisfy the community expectations (legislative objectives) and relevant stakeholders' expectations (design objectives). The fire safety objectives for the project are summarized below.

### **2.1 Legislative objectives**

The following are the fire safety objectives of the BCA:

1. Safeguard people from illness or injury due to a fire in a building.
2. Safeguard occupants from illness or injury while evacuating a building during a fire.
3. Facilitate the activities of emergency services personnel.
4. Avoid the spread of fire between buildings.
5. Protect other property from physical damage caused by structural failure of a building as a result of fire.

### **2.2 Design objectives**

The client requested that a fire safety engineering assessment be provided to support the performance-based building design as outlined in Section 9 of this report.

Objectives such as protection of property; protection of furnishings; protection of reputation and ensuring business continuity; safety other than fire safety; have not been identified as design objectives of this assessment. However, by satisfying the core fire safety objectives some of the above objectives may also be satisfied.

### 3. Assumptions & Limitations

The following assumptions and limitations apply to this FEB:

- a) This FEB outlines the methodology for the assessment of the Performance Solutions for the redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, and is limited to the deviations from the BCA DtS provisions as identified in Section 8.
- b) This FEB is developed on the assumption that all building works, except for the deviations identified in Section 8 of this report, shall comply with the DtS provisions of the BCA at the completion of the works.
- c) The Performance Solution outlined in this FEB is developed to demonstrate compliance with the relevant BCA Performance Requirements and may not provide the level of property protection inherent in a BCA DtS compliant design.
- d) This FEB relies on third parties, particularly the building surveyor, for the identification and confirmation of the deviations from the BCA DtS provisions and other information. This FEB does not provide a guarantee of the accuracy of the information provided by third parties.

The full list of assumptions and limitations is provided in Appendix A of this report.

## 4. Principal Building Characteristics

### 4.1 General

The GSC is an existing regional shopping centre located at 284 Collier Road, the corner of Collier and Walter Roads, Morley, WA 6062, and is proposed to be redeveloped in stages. The location plan is illustrated in Figure 1 below.



Figure 1: Location Plan of Galleria Shopping Centre

The shopping centre consists of major retailers including Woolworths, Coles, Kmart, Aldi, Target, Rebel Sports, Myer, Event Cinemas and facilities including toilets, restrooms, info desk, lost and found, wheelchair hire, payphones, recycling stations, Uber and Taxi bays.

The scope of redevelopment for this stage includes the north part of the Ground Floor and First Floor retail mall areas and the adjacent tenancies, excluding any major tenancies.

In accordance with the DtS provisions of the BCA and based on the advice provided by the building surveyor the building has the following characteristics:

| Characteristic                | Description                                                  |
|-------------------------------|--------------------------------------------------------------|
| Classification                | Class 6 (retail), Class 7a (car park), Class 9b (cinema)     |
| Number of Storeys Contained   | 3<br>(Ground Floor, First Floor and Mezzanine)               |
| Effective Height              | 10 m                                                         |
| Type of Construction Required | Type B                                                       |
| Large Isolated Building       | Yes – the tenancies are located in a large isolated building |

Table 2: Building Characteristics



## 4.2 Area of Works

The extent of the proposed refurbishment works is highlighted pink in Figure 2 and Figure 3 below. This report focuses on the areas only. The remaining existing, un-altered parts of the shopping centre will not be assessed.

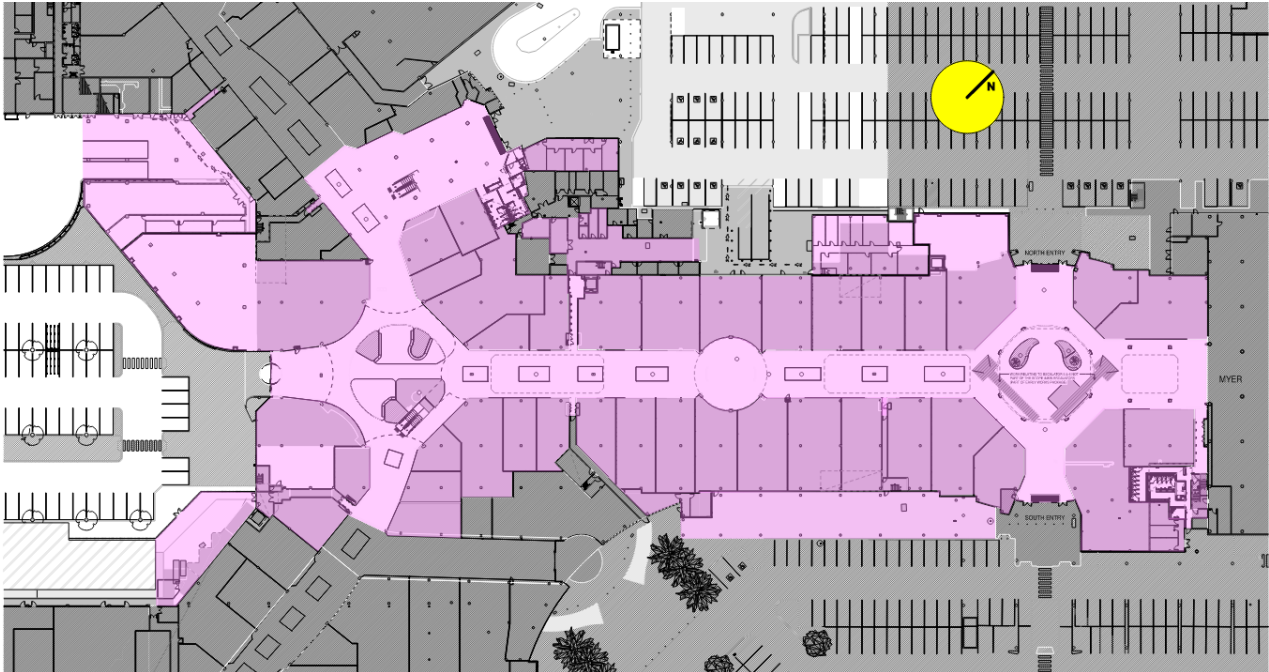


Figure 2: Extend of refurbishment on the Ground Floor of GSC

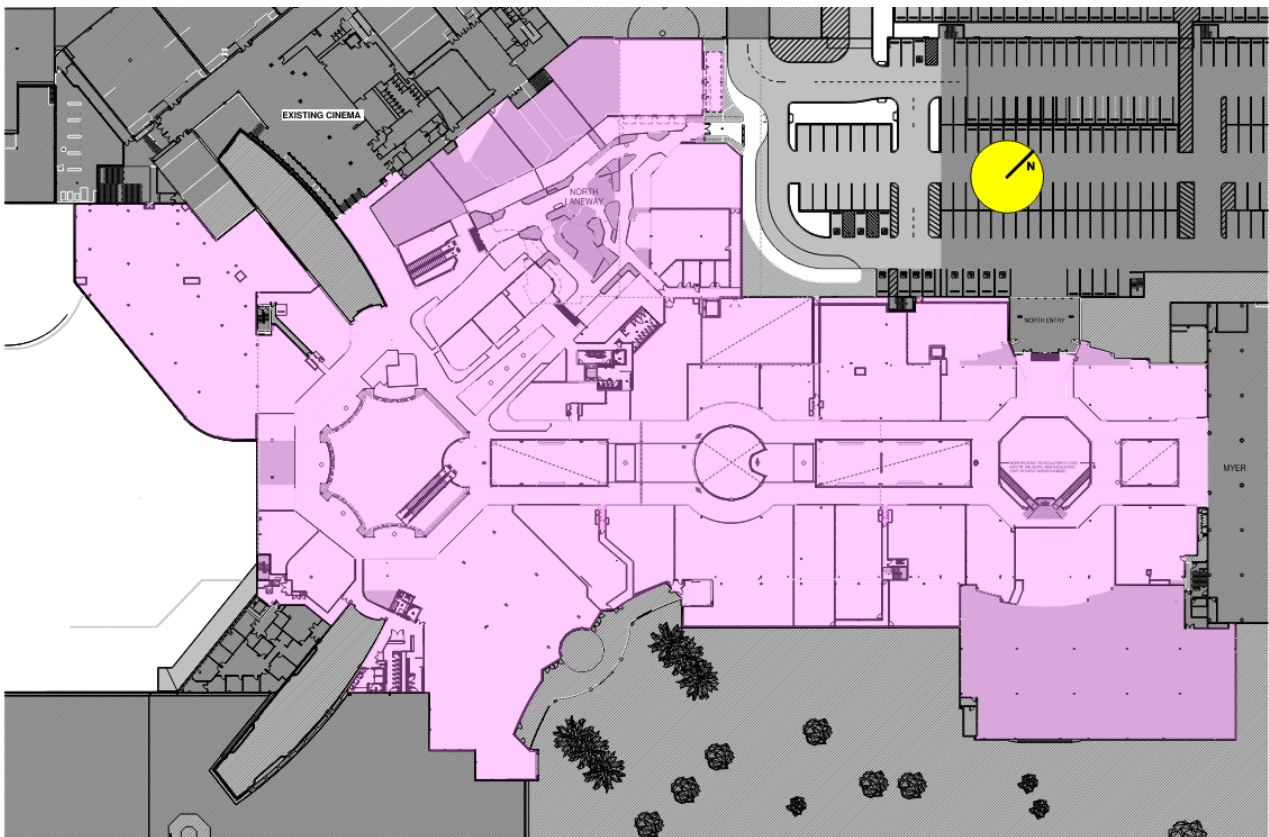


Figure 3: Extend of refurbishment on the First Floor of GSC.



### 4.3 Fire Compartment

The centre is being treated as a large-isolated building and therefore is to be designed as a single fire compartment, except the following existing conditions that are to be retained:

- Myer is currently fire separated from the main centre by fire walls fitted with sliding fire doors
- Kmart, Coles, Woolworths, Target, and the Cinemas are smoke separated.

Figure 4 and Figure 5 below show the fire-separated Myer tenancy in red, the smoke-separated tenancies in blue, the remaining tenancies in orange, and the retail mall circulation spaces in green.

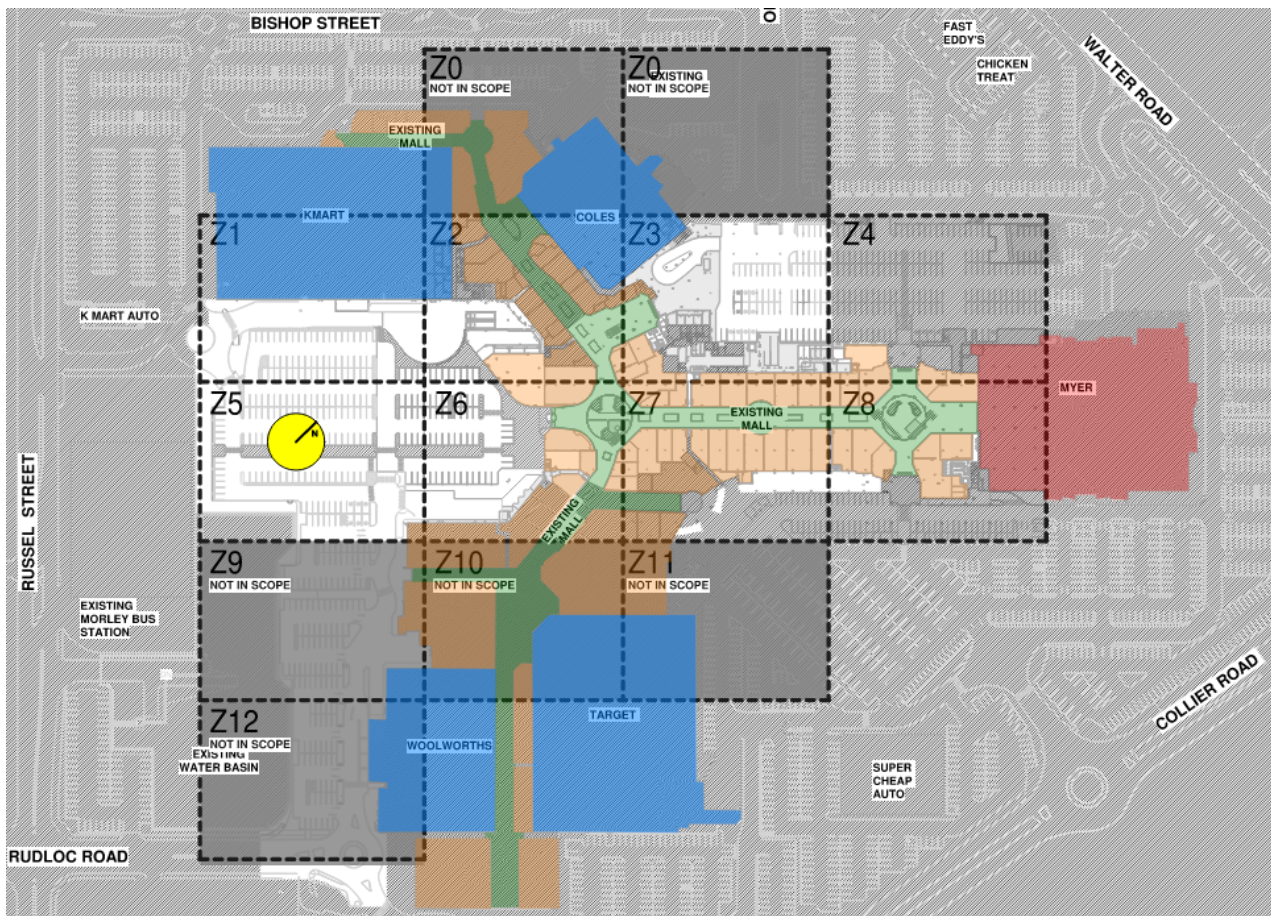


Figure 4: Ground Floor tenancies fire/smoke separated from main shopping centre



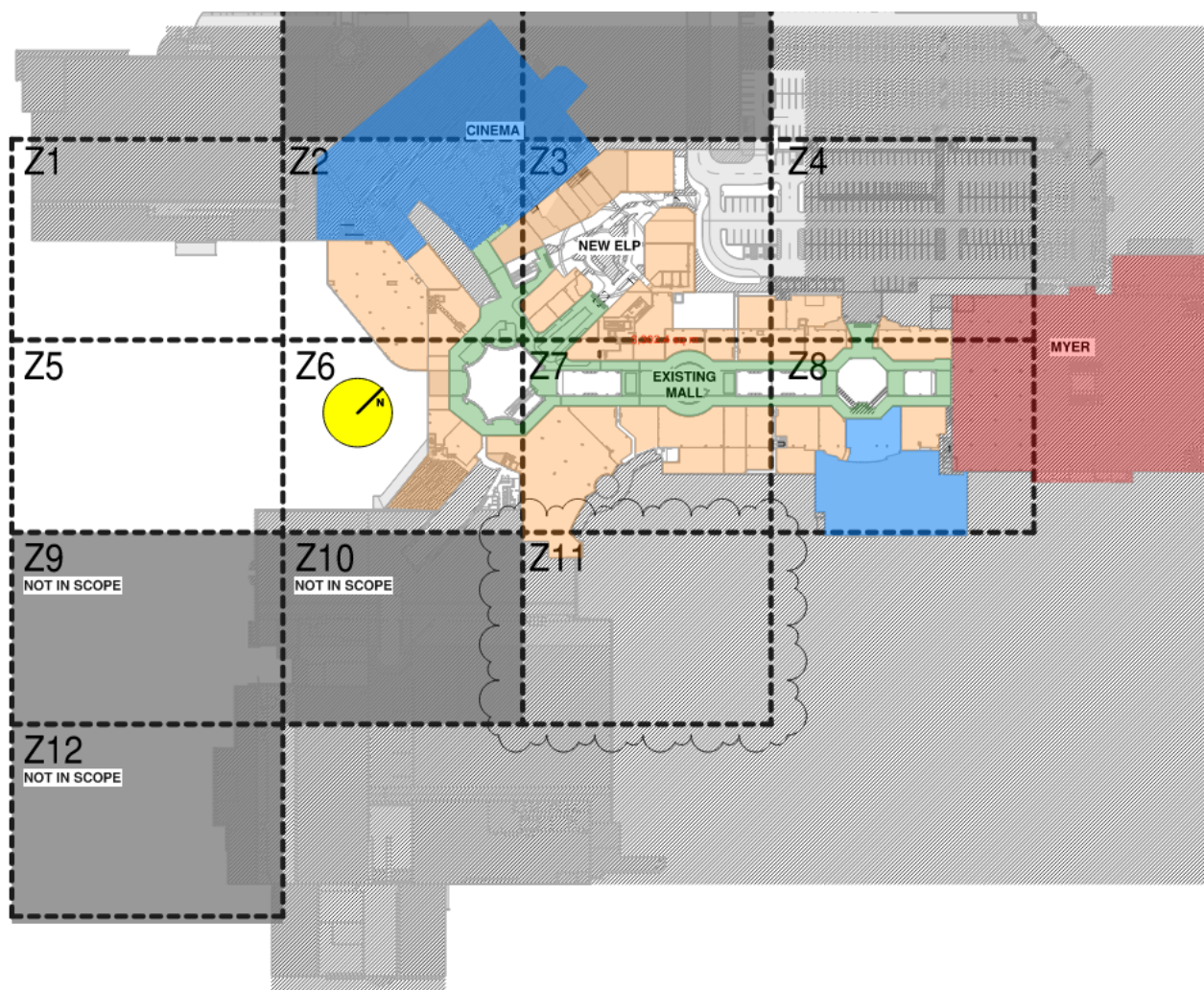


Figure 5: First Floor tenancies fire/smoke separated from main shopping centre

#### 4.4 Smoke Zones

The centre is separated into smoke zones as shown in Figure 6 and Figure 7 below (full size drawings of the smoke zones are provided in Appendix E). Each smoke zone is provided with dedicated smoke exhaust, as outlined in Table 3. Smoke zones SZ-01 and SZ-04 are outside the scope but smoke exhaust fans in these zones may activate during a fire in smoke zone SZ-02.

| Smoke zone | Smoke Exhaust Fans                     | Design SEF capacity, l/s | Actual SEF capacity, l/s |
|------------|----------------------------------------|--------------------------|--------------------------|
| SZ-01      | SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5 | 64,000                   | 48,352                   |
| SZ-02      | SEF 13.1; SEF 17.6; SEF 21.5           | 69,000                   | 63,069                   |
| SZ-03(A)   | SEF 10.2; SEF 19.2                     | 46,000                   | 50,681                   |
| SZ-03(B)   | SEF 15.1; SEF 16.2                     | 46,000                   | 51,853                   |
| SZ-03(C)   | SEF 12.1; SEF 12.2                     | 46,000                   | 50,238                   |
| SZ-04      | SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4 | 64,000                   | 31,613                   |

Table 3: Smoke zones and smoke exhaust capacity per each zone

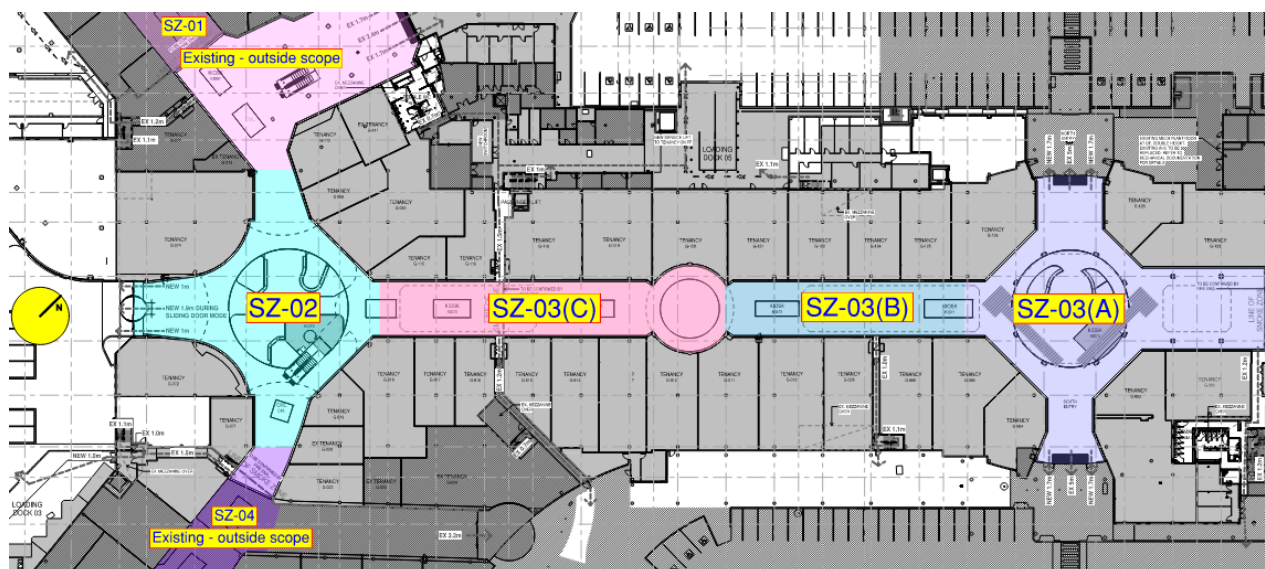


Figure 6: Ground Floor smoke zones

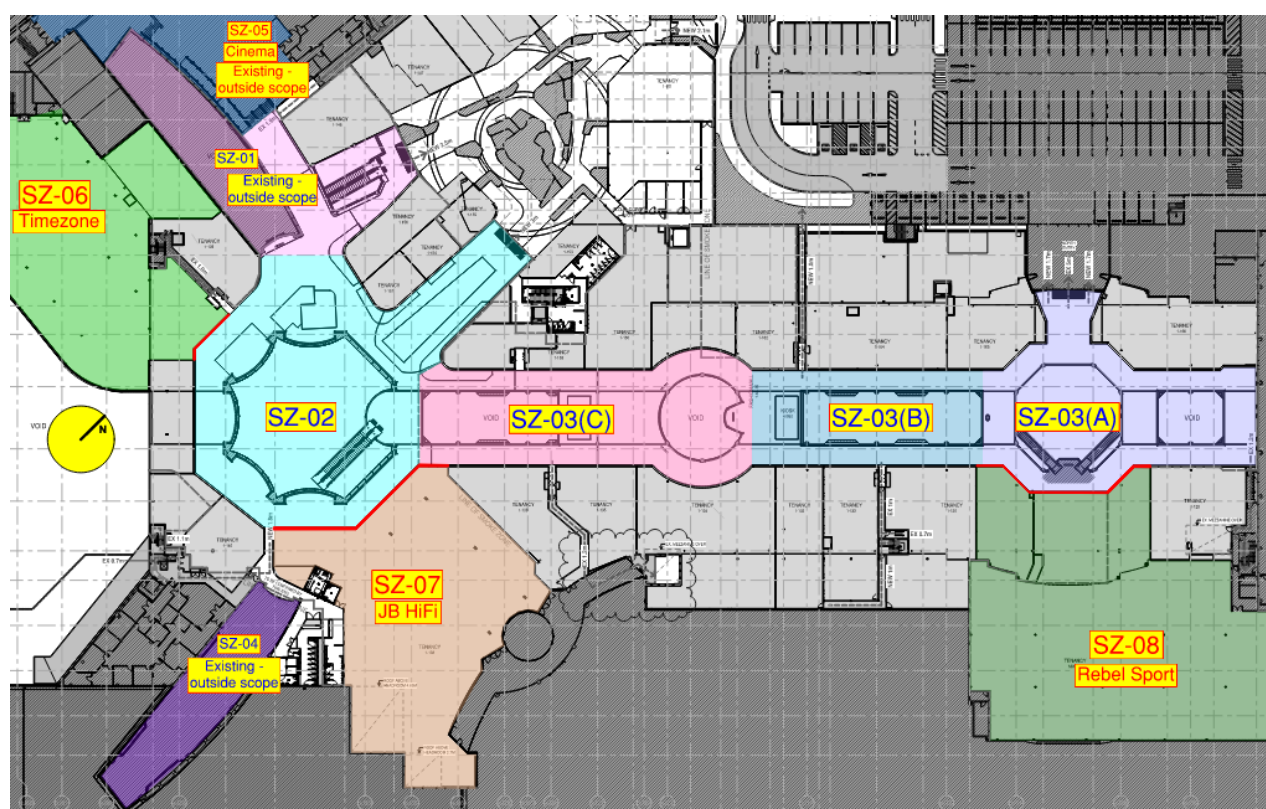


Figure 7: First Floor smoke zones

Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 4 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 5 below. AHUs shall provide make-up air to the retail malls at Ground Floor only.



| Plant Room                                                                                                | Air Handling Units        | Design make-up air capacity, l/s |
|-----------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------|
| <b>Shall supply make-up air independent of where fire is detected (SZ-01, SZ-02, SZ-03(A-C) or SZ-04)</b> |                           |                                  |
| AP7                                                                                                       | AHU 7.1                   | 1,250                            |
| AP Coles                                                                                                  | AHU Coles                 | 15,000                           |
| <b>Sub-total:</b>                                                                                         |                           | <b>16,250</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-01</b>                                   |                           |                                  |
| AP3                                                                                                       | AHU 3.2                   | 1,100                            |
| AP4                                                                                                       | AHU 4.1; AHU 4.2          | 10,250                           |
| AP6                                                                                                       | AHU 6.1                   | 4,000                            |
| AP8                                                                                                       | AHU 8.1                   | 8,000                            |
| AP9                                                                                                       | AHU 9.1                   | 7,500                            |
| AP11                                                                                                      | AHU 11.1                  | 3,500                            |
| <b>Sub-total:</b>                                                                                         |                           | <b>34,350</b>                    |
| <b>Total for smoke zone SZ-01</b>                                                                         |                           | <b>50,600</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-02</b>                                   |                           |                                  |
| AP1                                                                                                       | AHU 1.1                   | 5,000                            |
| AP3                                                                                                       | AHU 3.1                   | 2,200                            |
| AP4                                                                                                       | AHU 4.3                   | 6,000                            |
| AP6                                                                                                       | AHU 6.1                   | 4,000                            |
| AP8                                                                                                       | AHU 8.1                   | 8,000                            |
| AP9                                                                                                       | AHU 9.1                   | 7,500                            |
| AP11                                                                                                      | AHU 11.1                  | 3,500                            |
| <b>Sub-total:</b>                                                                                         |                           | <b>36,200</b>                    |
| <b>Total for smoke zone SZ-02</b>                                                                         |                           | <b>52,450</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-03(A-C)</b>                              |                           |                                  |
| AP1                                                                                                       | AHU 1.1                   | 5,000                            |
| AP3                                                                                                       | AHU 3.1; AHU 3.2          | 3,300                            |
| AP4                                                                                                       | AHU 4.1; AHU 4.2; AHU 4.3 | 16,250                           |
| AP6                                                                                                       | AHU 6.1                   | 4,000                            |
| <b>Sub-total:</b>                                                                                         |                           | <b>28,550</b>                    |
| <b>Total for smoke zone SZ-03(A-C)</b>                                                                    |                           | <b>44,800</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-04</b>                                   |                           |                                  |
| AP1                                                                                                       | AHU 1.1                   | 5,000                            |

| Plant Room                        | Air Handling Units | Design make-up air capacity, l/s |
|-----------------------------------|--------------------|----------------------------------|
| AP3                               | AHU 3.1; AHU 3.2   | 3,300                            |
| AP4                               | AHU 4.2; AHU 4.3   | 10,750                           |
| AP8                               | AHU 8.1            | 8,000                            |
| AP9                               | AHU 9.1            | 7,500                            |
| AP11                              | AHU 11.1           | 3,500                            |
| <b>Sub-total:</b>                 |                    | <b>38,050</b>                    |
| <b>Total for smoke zone SZ-04</b> |                    | <b>54,300</b>                    |

Table 4: AHUs that shall provide make-up air to the smoke exhaust systems

| Door          | Location                                          | Size, m     | Net free open area, m <sup>2*</sup> |
|---------------|---------------------------------------------------|-------------|-------------------------------------|
| D.EX.01       | South-east entrance to Woolworths and Target mall | 2.55 x 2.91 | 6.55                                |
| D.EX.02       | South-west entrance to Target link mall           | 2.45 x 2.40 | 5.16                                |
| D.EX.03       | South-west entrance to Kmart mall                 | 1.74 x 2.35 | 3.38                                |
| D.EX.04       | North-west entrance to Coles mall                 | 1.65 x 2.35 | 3.17                                |
| D.EX.05       | North-east entrance to ANZ mall                   | 3.29 x 2.41 | 7.20                                |
| D.EX.06       | North entrance to Coles mall                      | 2.06 x 2.41 | 4.24                                |
| 1.Z6.01       | South entrance to Plaza (new)                     | 2.03 x 2.45 | 4.24                                |
| G.Z4.03       | North-west entrance to Myer mall                  | 2.86 x 2.63 | 6.73                                |
| G.Z8.02       | South-east entrance to Myer mall                  | 2.35 x 2.27 | 4.65                                |
| <b>Total:</b> |                                                   |             | <b>45.32</b>                        |

Table 5: External doors that shall provide make-up air to the smoke exhaust system

Note \*: the effective width of the doors is reduced by 300 mm as sliding doors leave a 150 mm overlap each side of the opening.

All AHUs that are not supplying make-up air to the fire-affected smoke zone shall shut down on fire trip.

#### 4.5 Department of Fire & Emergency Services Access

GSC is provided with three (3) access points (crossovers) from Walter Road, two (2) access points from Collier Road, three (3) access points from Russell Street and one (1) access point from Dewar Street, facilitating vehicle and pedestrian access for the Department of Fire & Emergency Services (DFES).

The DFES response to GSC is expected to come from the Kiara Fire Station located approximately 5.0 km to the north-east, and Malaga Fire Station located approximately 5.9 km to the north. Figure 8 shows the location of the site relative to these fire stations.

The nearest back-up fire stations are Vincent Fire Station, located approximately 6.9 km to the south-west and Osborne Park fire station located approximately 9.6 km to the west.

The nearest aerial appliance is at Perth Fire Station.

The abovementioned fire stations are manned by DFES personnel on a full-time basis.

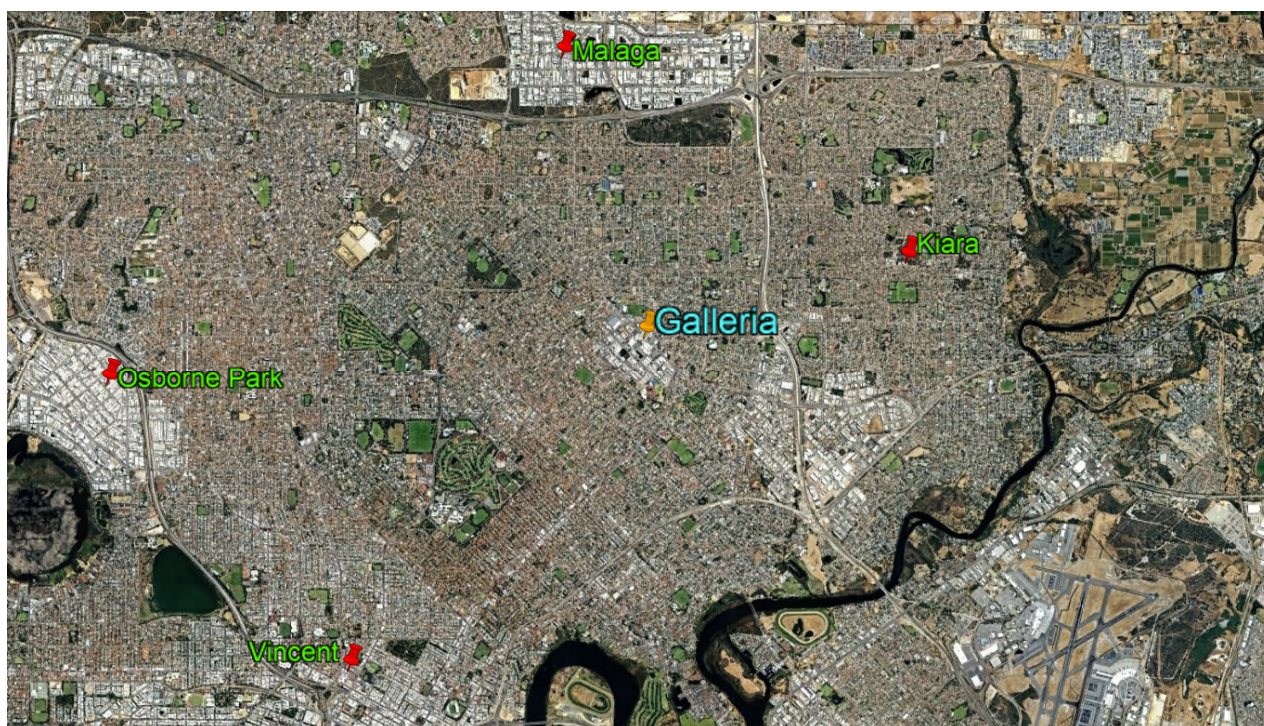


Figure 8: DFES locations relative to the site (image courtesy of Google Earth)

#### 4.6 Egress Provisions

The centre is provided with multiple exits around the perimeter of the centre. The number of exits withstanding, the centre is subject to extended travel distances to a single point of choice from the specialty tenancies and extended travel distances to the nearest of the alternative exits from the centre. The performance-based egress provisions are subject of Performance Solutions No. 3, No. 4 and No. 5.

#### 4.7 Preventive and Protective Measures

The fire preventive and protective measures include various passive and active fire protection measures. The Australian Fire Engineering Guidelines (AFEG) indicate that to assist in analysing a fire safety system, it is convenient to consider the system as comprising six 'sub-systems' [ABCB, 2021a]. Therefore, preventive and protective measures detailed in Table 6 are grouped in accordance with the different 'sub-systems' recommended by the AFEG.

| Sub-System                                                         | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sub-System A</b><br>Fire Initiation and Development and Control | <p>Strict enforcement of a “No-Smoking” policy shall be implemented throughout the building.</p> <p>Strict enforcement of housekeeping measures to ensure rubbish is not accumulated adjacent to potential ignition sources.</p> <p>Regular maintenance and inspection of all electrical equipment and appliances shall be enforced in accordance with the relevant regulations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Sub-System B</b><br>Smoke Spread and Control                    | <p>The GSC is a single fire compartment but is divided into fire- and smoke-separated areas.</p> <p>In the initial stages of fire development smoke spread within smoke-separated areas may be limited by the internal walls.</p> <p>The performance-based smoke exhaust system in the retail malls is expected to control smoke spread in the shopping centre. The performance-based smoke exhaust system is subject of Performance Solution No. 5.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Sub-System C</b><br>Fire Spread and Impact and Control          | <p>The GSC is a single fire compartment but is divided into fire- and smoke-separated areas.</p> <p>Automatic sprinklers installed throughout the building to AS 2118.1 are expected to control a potential fire. In the unlikely event that the sprinkler system fails to operate as designed, non-fire-rated intertenancy walls should provide temporary barriers in the path of spreading fire.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Sub-System D</b><br>Fire Detection, Warning and Suppression     | <p>An automatic fire sprinkler system in accordance with BCA Clause E1D4, Specification 17 and AS 2118.1-2017 shall be provided throughout the area within the scope of this project, except sprinklers may be omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy. Omission of sprinklers is subject of Performance Solution No. 10. (Sprinklers are not prescribed in the open-deck carpark to the north-west of the centre.)</p> <p>A fire detection and alarm system in accordance with Clauses S20C4 and S20C6 of BCA Specification 20 and AS 1670.1-2018 shall be provided throughout the area within the scope of this project.</p> <p>Emergency Warning and Intercommunication System (EWIS) shall be provided in accordance with Clause E4D9(d) of BCA and AS 1670.4-2018 throughout the area within the scope of this project and in the Centre Management Office.</p> <p>Fire hose reels may be omitted throughout the area within the scope of this project. The performance-based omission of fire hose reels is subject of Performance Solution No. 9.</p> <p>Portable fire extinguishers shall be installed in accordance with BCA Clause E1D14 and AS 2444-2001 (where applicable).</p> |
| <b>Sub-System E</b><br>Occupant Evacuation                         | <p>The building is provided with multiple exits; however, extended travel distances are present. These extended travel distances are subject of Performance Solutions No. 3, No. 4 and No. 5.</p> <p>Emergency lighting and exit signage shall be provided in accordance with Part E4 of the BCA.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |



| Sub-System                                           | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sub-System F</b><br>Fire Services<br>Intervention | Professional fire service (DFES) is available on a full-time basis.<br><br>A fire hydrant system shall be provided in accordance with BCA Clause E1D2 and AS 2419.1-2021 throughout the area within the scope of this project, except complete fire hose coverage is achieved with the use of 3 lengths of hose from external attack fire hydrants, in lieu of 2 lengths of hose, and with 2 lengths of hose from internal attack fire hydrants in lieu of a single length of hose. The performance-based fire hose coverage is subject of Performance Solution No. 8. |

*Table 6: Preventative and protective measures*

#### 4.8 Hazards

Identification of hazards that are expected to affect life safety of building occupants is crucial to undertaking a fire safety engineering assessment. Special attention must be paid to those hazards that are not commonly associated with the type of occupancy.

Hazards associated with the general layout and activities as well as the ignition and fuel sources are identified in Table 7 below:

| Type             | Comment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General Layout   | Multiple alternative exits are provided from the building, although some travel distances to exits and distances between the alternative exits exceed the BCA DtS prescribed maximums. This is mitigated by the provision of a performance-based smoke exhaust system in the retail mall and early warning fire detection and alarm system to AS 1670.1-2018 throughout the area within the scope of this project.<br><br>The general layout of the building is not considered to present an unusual hazard to occupants and is consistent with the building classification and a regional shopping centre. |
| Activities       | The activities within the building are considered to be of low to medium hazard and are not considered to promote any additional hazards to those typical of this type of occupancy.<br><br>The above notwithstanding, acts of vandalism that could lead to deliberately lit fires cannot be discarded and shall be address through the implementation of adequate security procedures.                                                                                                                                                                                                                     |
| Ignition Sources | The main ignition sources throughout the building are expected to be faulty electrical wiring, lighting, or electrical equipment.<br><br>In areas where food is being prepared or re-heated the kitchen appliances may become an ignition source.<br><br>The strict enforcement of the “No-Smoking” policy throughout the building shall reduce the likelihood of discarded smoking materials or use of open flames, such as matches and/or lighters; becoming an ignition source.                                                                                                                          |
| Fuel Sources     | The main fuel source within the building is expected to consist of retail goods for sale, either in the retail areas or in the back-of-house areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

*Table 7: Hazards and ignition source*

## 4.9 Occupant Characteristics

### 4.9.1 Occupant Groups

The characteristics of the occupant groups expected to be present in the building when a fire starts, are detailed below:

1. Management, support personnel and security – This occupant group is expected to have good familiarity with the building and the fire safety measures and is expected to be fully trained in emergency procedures. This occupant group is expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the building.
2. Retail Staff – This occupant group is expected to have good familiarity with their respective tenancies and reasonable familiarity with the rest of the centre. Staff should have good familiarity with the fire safety measures. This occupant group is expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the tenancy and is expected to facilitate evacuation in an emergency.
3. Customers – This occupant group may or may not be familiar with the layout of the building. Occupants in this group are expected to have mobility, hearing and visual abilities in line with the general population. This occupant group may require assistance with walking and may have mobility, hearing, and visual impairments in line with the general public.
4. External maintenance contractors – This occupant group is expected to have reasonable familiarity with the building. This occupant group is also expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. Contractors are expected to be awake and aware of their surroundings at all times when inside the tenancy.

In addition to the above, in an emergency DFES are expected to enter the building as part of their fire brigade intervention activities.

### 4.9.1 Number of Occupants

BCA Clause D2D18 states that the number of persons accommodated in a building must be determined with consideration of the purpose for which it is used and the layout of the floor area. It also states that the number of persons accommodated in a building may be determined using either BCA Clause D2D18(a) and Table D2D18, or by using BCA Clause D2D18(c) which utilises “*any other suitable means of assessing its capacity*”.

In determining the population of the GSC relevant to this assessment the following assumptions were made:

1. Occupant numbers for the GSC were based on the “Fire Safety in Shopping Centres” research report, also known as Project 6 [FCRRP, 1998a], i.e. as permitted by BCA Clause D2D18(c), i.e. 6 m<sup>2</sup>/person for trading floor and specialty shops, and 10 m<sup>2</sup>/person for the retail mall.
2. Customers can access the trading floors of the Major and Mini-Major Stores, but not the back-of-house (BoH) areas; therefore, only the floor area of the trading floors were used to determine occupant numbers.
3. Occupant numbers for the BoH were based on BCA Table D2D18 provisions for “storage space” (30 m<sup>2</sup>/person). Occupant numbers for the offices were based on BCA Table D2D18 provisions for “office” (10 m<sup>2</sup>/person).
4. Customers can access all areas of Specialty Shops, Food Tenancies, or retail mall; therefore, the gross floor area of the shops and retail malls was used to determine the occupant numbers.
5. Occupants from specialty shops that open directly to outside and do not have alternative escape paths via the retail mall are not competing for the same exits with occupants from within the retail mall and specialty shops that open onto the retail mall; hence they are not included in the assessment.
6. Where a specialty shop is provided with an exit directly to outside and an alternative escape path via the mall, the total population of the tenancy was divided by the number of exits and was evacuated accordingly, e.g. if there is one exit directly to outside and one alternative escape path via the retail mall, ½ of the population is evacuated directly to outside and ½ via the retail mall.

For the purposes of this fire engineering analysis, the number of occupants evacuating via the retail malls from the area of scope was calculated to be 3,236 people.

## 5. Assessment Data

The following data was examined during the production of this FEB:

1. The project architectural drawings listed in Table 8 below prepared by the architect (Buchan; project no.: 19049A).

| Drawing No. | Title/Description                  | Revision | Date       |
|-------------|------------------------------------|----------|------------|
| 00004       | Location Plan                      | C        | 06.06.2025 |
| 00005       | GA Ground Floor – Zones Map 1 of 2 | D        | 06.06.2025 |
| 00006       | GA First Floor – Zones Map 2 of 2  | D        | 06.06.2025 |
| 00007       | GA Ground Floor – Scope of Work    | D        | 06.06.2025 |
| 00008       | GA First Floor – Scope of Work     | D        | 06.06.2025 |
| 01000       | MLP Ground Floor – With Name       | E        | 06.06.2025 |
| 01002       | MLP First Floor – With Name        | E        | 06.06.2025 |
| 16000       | Ground Floor Control Plan          | E        | 06.06.2025 |
| 16100       | First Floor Control Plan           | E        | 06.06.2025 |
| 20001       | Ground Floor Plan Z1               | E        | 06.06.2025 |
| 20002       | Ground Floor Plan Z2               | E        | 06.06.2025 |
| 20003       | Ground Floor Plan Z3               | E        | 06.06.2025 |
| 20004       | Ground Floor Plan Z4               | E        | 06.06.2025 |
| 20005       | Ground Floor Plan Z5               | E        | 06.06.2025 |
| 20006       | Ground Floor Plan Z6               | E        | 06.06.2025 |
| 20007       | Ground Floor Plan Z7               | E        | 06.06.2025 |
| 20008       | Ground Floor Plan Z8               | E        | 06.06.2025 |
| 20102       | First Floor Plan Z2                | E        | 06.06.2025 |
| 20103       | First Floor Plan Z3                | E        | 06.06.2025 |
| 20104       | First Floor Plan Z4                | F        | 06.06.2025 |
| 20105       | First Floor Plan Z5                | E        | 06.06.2025 |
| 20106       | First Floor Plan Z6                | E        | 06.06.2025 |
| 20107       | First Floor Plan Z7                | E        | 06.06.2025 |
| 20108       | First Floor Plan Z8                | C        | 06.06.2025 |
| 20111       | First Floor Plan Z11               | E        | 06.06.2025 |
| 20202       | Roof Plan Z2                       | E        | 06.06.2025 |
| 20203       | Roof Plan Z3                       | E        | 06.06.2025 |
| 20204       | Roof Plan Z4                       | E        | 06.06.2025 |



| Drawing No. | Title/Description                      | Revision | Date       |
|-------------|----------------------------------------|----------|------------|
| 20205       | Roof Plan Z5                           | E        | 06.06.2025 |
| 20206       | Roof Plan Z6                           | E        | 06.06.2025 |
| 20207       | Roof Plan Z7                           | E        | 06.06.2025 |
| 20208       | Roof Plan Z8                           | E        | 06.06.2025 |
| 30002       | Ground Floor RCP Z2                    | E        | 06.06.2025 |
| 30003       | Ground Floor RCP Z3                    | E        | 06.06.2025 |
| 30004       | Ground Floor RCP Z4                    | E        | 06.06.2025 |
| 30005       | Ground Floor RCP Z5                    | E        | 06.06.2025 |
| 30006       | Ground Floor RCP Z6                    | E        | 06.06.2025 |
| 30007       | Ground Floor RCP Z7                    | E        | 06.06.2025 |
| 30008       | Ground Floor RCP Z8                    | E        | 06.06.2025 |
| 30102       | First Floor RCP Z2                     | E        | 06.06.2025 |
| 30103       | First Floor RCP Z3                     | E        | 06.06.2025 |
| 30104       | First Floor RCP Z4                     | E        | 06.06.2025 |
| 30105       | First Floor RCP Z5                     | C        | 06.06.2025 |
| 30106       | First Floor RCP Z6                     | D        | 06.06.2025 |
| 30107       | First Floor RCP Z7                     | D        | 06.06.2025 |
| 30108       | First Floor RCP Z8                     | D        | 06.06.2025 |
| 30111       | First Floor RCP Z11                    | C        | 06.06.2025 |
| 18001       | Ground Floor FRL Egress Plan           | F        | 06.06.2025 |
| 18002       | Ground Floor Mezzanine FRL Egress Plan | F        | 06.06.2025 |
| 18003       | First Floor FRL Egress Plan            | F        | 06.06.2025 |
| 18004       | First Floor Mezzanine FRL Egress Plan  | A        | 06.06.2025 |
| 40001       | Elevations North & South Entrances 2&3 | A        | 06.06.2025 |
| 40002       | Elevations Plaza                       | A        | 06.06.2025 |
| 40003       | Elevations Terrace                     | A        | 06.06.2025 |
| 50001       | Sections 1                             | C        | 06.06.2025 |
| 50002       | Sections 2                             | D        | 06.06.2025 |
| 50003       | Sections 3                             | D        | 06.06.2025 |
| 50004       | Sections 4                             | D        | 06.06.2025 |
| 50005       | Sections 5                             | D        | 06.06.2025 |

*Table 8: Project architectural drawings schedule*

2. The structure drawings listed in Table 9 below prepared by HERA Engineering (project no.: 24077).

| Drawing No. | Title/Description                              | Revision | Date       |
|-------------|------------------------------------------------|----------|------------|
| 0L-1-001    | Ground Level General Arrangement – Zone 1      | B        | 23.05.2025 |
| 0L-2-002    | Ground Level General Arrangement – Zone 2      | F        | 21.07.2025 |
| 0L-3-003    | Ground Level General Arrangement – Zone 3      | G        | 21.07.2025 |
| 0L-4-004    | Ground Level General Arrangement – Zone 4      | F        | 21.07.2025 |
| 0L-6-006    | Ground Level General Arrangement – Zone 6      | E        | 21.07.2025 |
| 0L-7-007    | Ground Level General Arrangement – Zone 7      | E        | 21.07.2025 |
| 0L-8-008    | Ground Level General Arrangement – Zone 8      | G        | 21.07.2025 |
| 1L-1-001    | Level 1 General Arrangement – Zone 1           | B        | 23.05.2025 |
| 1L-2-002    | Level 1 General Arrangement – Zone 2           | E        | 21.07.2025 |
| 1L-3-003    | Level 1 General Arrangement – Zone 3           | G        | 21.07.2025 |
| 1L-4-004    | Level 1 General Arrangement – Zone 4           | F        | 21.07.2025 |
| 1L-6-006    | Level 1 General Arrangement – Zone 6           | F        | 21.07.2025 |
| 1L-7-007    | Level 1 General Arrangement – Zone 7           | F        | 21.07.2025 |
| 1L-8-008    | Level 1 General Arrangement – Zone 8           | G        | 21.07.2025 |
| RF-2-002    | Roof Awning Level General Arrangement – Zone 2 | D        | 23.05.2025 |
| RF-2-102    | Roof Level General Arrangement – Zone 2        | D        | 23.05.2025 |
| RF-2-202    | Upper Roof Level General Arrangement – Zone 2  | E        | 13.06.2025 |
| RF-3-003    | Roof Awning Level General Arrangement – Zone 3 | E        | 13.06.2025 |
| RF-3-103    | Roof Level General Arrangement – Zone 3        | F        | 16.06.2025 |
| RF-4-004    | Roof Awning Level General Arrangement – Zone 4 | D        | 23.05.2025 |
| RF-4-104    | Roof Level General Arrangement – Zone 4        | E        | 13.06.2025 |
| RF-6-006    | Roof Awning Level General Arrangement – Zone 6 | E        | 13.06.2025 |
| RF-6-106    | Roof Level General Arrangement – Zone 6        | D        | 23.05.2025 |
| RF-6-206    | Upper Roof Level General Arrangement – Zone 6  | D        | 23.05.2025 |
| RF-7-007    | Roof Awning Level General Arrangement – Zone 7 | D        | 23.05.2025 |
| RF-7-107    | Roof Level General Arrangement – Zone 7        | E        | 13.06.2025 |
| RF-8-008    | Roof Awning Level General Arrangement – Zone 8 | D        | 23.05.2025 |
| RF-8-108    | Roof Level General Arrangement – Zone 8        | E        | 13.06.2025 |

*Table 9: Structures drawings schedule*

3. The fire services drawings listed in Table 9 below prepared by Firesafe Group Pty Ltd (project no.: WCS25009). A copy can be found in Appendix D of this report.

| Drawing No. | Title/Description                                             | Revision | Date       |
|-------------|---------------------------------------------------------------|----------|------------|
| 0L-0-401    | Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 00 | D        | 13.06.2025 |
| 1L-0-401    | Fire Wet – Main Works Fire Hydrant Coverage Layout – Level 01 | E        | 13.06.2025 |

*Table 10: Fire services drawings schedule*

## 6. Relevant Stakeholders

This FEB was prepared by BCA Consultants in collaboration and consultation with the relevant stakeholders identified in Table 11 below:

| Name               | Organisation     | Role                      | Email Address                                                                                |
|--------------------|------------------|---------------------------|----------------------------------------------------------------------------------------------|
| Brendan O'Regan    | DFES             | Fire Engineer             | <a href="mailto:Brendan.O'Regan@dfes.wa.gov.au">Brendan.O'Regan@dfes.wa.gov.au</a>           |
| Alexis Wake        | DFES             | Fire Safety Officer       | <a href="mailto:Alexis.Wake@dfes.wa.gov.au">Alexis.Wake@dfes.wa.gov.au</a>                   |
| James Fudge        | Vicinity Centres | Client                    | <a href="mailto:james.fudge@vicinity.com.au">james.fudge@vicinity.com.au</a>                 |
| Nikola Stojanovic  | Built Plus       | Project manager client    | <a href="mailto:nik.stojanovic@buildplusgroup.com">nik.stojanovic@buildplusgroup.com</a>     |
| Chris West         | Built Plus       | Project manager client    | <a href="mailto:chris.west@buildplusgroup.com">chris.west@buildplusgroup.com</a>             |
| Rebecca Creamer    | Multiplex        | Design manager            | <a href="mailto:Rebecca.Creamer@multiplex.global">Rebecca.Creamer@multiplex.global</a>       |
| Kylie Judd         | Multiplex        | Project manager           | <a href="mailto:Kylie.Judd@multiplex.global">Kylie.Judd@multiplex.global</a>                 |
| Vincent Chi        | Buchan           | Architect                 | <a href="mailto:Vincent.Chi@buchan.au">Vincent.Chi@buchan.au</a>                             |
| Chris Bright       | Link Engineering | Mechanical engineer       | <a href="mailto:chris@linkengineering.com.au">chris@linkengineering.com.au</a>               |
| Rebecca Boston     | Firesafe         | Fire services engineer    | <a href="mailto:rebecca.boston@firesafegroup.com.au">rebecca.boston@firesafegroup.com.au</a> |
| Mark Viska         | BCA Consultants  | Building surveyor         | <a href="mailto:mviska@bcagroup.com.au">mviska@bcagroup.com.au</a>                           |
| Chris Meisinger    | BCA Consultants  | Fire services peer review | <a href="mailto:cmeisinger@bcagroup.com.au">cmeisinger@bcagroup.com.au</a>                   |
| Amy Chao           | BCA Consultants  | Fire safety engineer      | <a href="mailto:achao@bcagroup.com.au">achao@bcagroup.com.au</a>                             |
| Alex Alexandrovski | BCA Consultants  | Fire safety engineer      | <a href="mailto:aalexandrovski@bcagroup.com.au">aalexandrovski@bcagroup.com.au</a>           |

Table 11: Relevant stakeholders

## 7. Fire Engineering Brief Process

The FEB process to date has consisted of the following stages:

- 1) Briefing by Buchan with regard to the project details and objectives.
- 2) E-mail correspondence and telephone conversations with the relevant stakeholders to confirm the extent of the deviations from the BCA DtS provisions and the proposed fire safety strategy.
- 3) A DRAFT FEB report (Revision A) was issued for stakeholders review on 17 April 2025.
- 4) An FEB meeting was held with the DFES Built Environment Branch (BEB) to discuss the project on 22 April 2025. A copy of the meeting minutes is provided in Appendix B of this report.
- 5) The FEB report (Revision B) was submitted to DFES for review and comments on 29 April 2025.
- 6) Since the submission of FEB Revision B to DFES, the design has changed with new Performance Solutions identified. The FEB was revised accordingly.
- 7) Revision C of the FEB report was issued for tender on 27 May 2025.
- 8) An FEB meeting was held with the DFES Built Environment Branch (BEB) on 3 June 2025 to discuss the changes to the fire safety strategy that was discussed in the first FEB meeting on 22 April 2025. A copy of the meeting minutes is provided in Appendix C of this report.
- 9) Revision D of the FEB report was issued for tender on 6 June 2025.
- 10) The configuration of the smoke exhaust system was modified to achieve an optimal performance. The FEB was revised accordingly.
- 11) Revision E of the FEB report was issued to the design team for review and comments on 11 August 2025.
- 12) The design team provided their comments, and the FEB was revised accordingly.
- 13) Revision F of the FEB report was issued to DFES for review and comments on 22 August 2025.



## 8. Summary of Performance Solutions and Relevant BCA Criteria

Table 12 provides a description of the Performance Solutions, the BCA Performance Requirements and the proposed assessment methods for the Performance Solutions that are addressed in this report.

| Perf. Sol. | Description of Performance Solutions                                                                                                                                                                                                                                                                     | DtS Provisions                                                 | Perform. Req's    | Assess. Method             |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------|----------------------------|
| 1          | The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120                                                                                                                                                                                                          | C2D2(2) and Table S5C21e                                       | C1P1              | A2G2(2)(b)(ii); A2G2(2)(d) |
|            | The loadbearing columns that support the First Floor slab achieve FRL 120/--/-- in lieu of FRL 180/--/--                                                                                                                                                                                                 | C2D2(2) and Table S5C21g                                       |                   |                            |
| 2          | MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 are either not located in fire-rated enclosures or are located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building                                                      | C3D14(2)(a)                                                    | C1P2(1)(d); EP2.2 | A2G2(2)(b)(ii)             |
|            | Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant are not fire-stopped                                                                                                                                                    | C4D15(2)                                                       | C1P2(1)(d)        |                            |
|            | Power supply to the AHUs that provide make-up air to the smoke exhaust systems is not fire-rated and is not enclosed in plant rooms that have FRL not less than --/120/120.                                                                                                                              | E2D15(2)(a), Cl. S21C7(7) of Spec. 21, Cl. 4.10.2.2(a) AS 1668 | E2P2              |                            |
| 3          | Travel distances for the non-fire-isolated exits are measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space | D2D5(3)(a)                                                     | D1P4; E2P2        | A2G2(2)(b)(ii)             |
| 4          | Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m                                                                                                                                                                                                  | D2D5(3)(a)                                                     | D1P4, E2P2        | A2G2(2)(d)                 |
|            | Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m                                                                                                                                                                                   |                                                                |                   |                            |
|            | Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m                                                                                                                                                 |                                                                |                   |                            |

| Perf. Sol. | Description of Performance Solutions                                                                                                                                                                                                                                                                                                                                                                                                                | DtS Provisions                                                                                                                                 | Perform. Req's | Assess. Method |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|
|            | Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                |                |                |
|            | Travel distances from FF amenities to a point of choice are extended up to 27 m in lieu of 20 m                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                |                |                |
|            | Travel distances from the GF BoH area to the nearest of the alternative exits are extended up to 50 m                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                |                |                |
| 5          | Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust are extended up to 61 m in lieu of 40 m                                                                                                                                                                                                                                                                                    | D2D5(3)(a)                                                                                                                                     | D1P4, E2P2     | A2G2(2)(b)(ii) |
|            | Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, are extended up to 118 m in lieu of 60 m                                                                                                                                                                                                                                                           | D2D6(c)(iii)                                                                                                                                   |                |                |
|            | Smoke exhaust rates are determined on a performance basis in lieu of compliance with the BCA DtS provisions                                                                                                                                                                                                                                                                                                                                         | E2D15(2)(a), Cl. S21C2(2) of Spec. 21                                                                                                          | E2P2           |                |
|            | Horizontal length of the Myer retail mall smoke reservoir is extended up to 144 m long in lieu of 60 m                                                                                                                                                                                                                                                                                                                                              | E2D15(2)(a), Cl. S21C4(2) of Spec. 21                                                                                                          |                |                |
|            | Horizontal length of the Plaza smoke reservoir is extended up to 66 m long in lieu of 60 m                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                |                |                |
|            | Make-up air velocity through vertical openings exceeds 1 m/s                                                                                                                                                                                                                                                                                                                                                                                        | E2D15(2)(a), Cl. S21C6(3) of Spec. 21                                                                                                          |                |                |
|            | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                   | The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03) |                |                |
| 7          | First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) in lieu of to a road or open space                                                                                                                                                                                                                                                                                                                      | D2D12(2)(a)                                                                                                                                    | D1P5, E2P2     | A2G2(2)(b)(ii) |
|            | Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space | D2D12(2)(b)                                                                                                                                    |                |                |

| Perf. Sol. | Description of Performance Solutions                                                                                                                                                                                                      | DtS Provisions                                                                             | Perform. Req's | Assess. Method |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------|----------------|
| 8          | Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m              | E1D2(2) and Cl. 3.5.3.3(b) of AS 2419.1-2021                                               | E1P3           | A2G2(2)(b)(ii) |
|            | Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m | E1D2(2) and Cl. 3.5.3.3(c) of AS 2419.1-2021                                               |                |                |
|            | Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m                                                       | E1D2(2) and Cl. 3.6.1(e) of AS 2419.1-2021                                                 |                |                |
|            | Internal fire hydrants are not located in every fire-isolated exit                                                                                                                                                                        | E1D2(2) and Cl. 3.6.2(a)(ii) of AS 2419.1-2021                                             |                |                |
|            | Internal fire hydrants installed in retail malls are provided more than 4 m from required exits                                                                                                                                           | E1D2(2) and Cl. 3.6.2(b) of AS 2419.1-2021                                                 |                |                |
| 9          | In the refurbished and extended parts of the GSC, the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, in lieu of fire hose reels                                                        | E1D3(2)(a)                                                                                 | E1P1           | A2G2(2)(b)(ii) |
| 10         | Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy       | Cl. 3.1.2 of AS 2118.1, S17C2(a) of BCA Spec. S17 and E1D4(b)                              | E1P4           | A2G2(2)(b)(ii) |
| 11         | The eastern canopies in the North Laneway are protected with vertical sidewall sprinklers on a performance basis.                                                                                                                         | E1D4(b), Cl. S17C2(a) of Spec. 17 and Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017 | E1P4           | A2G2(2)(b)(ii) |

| Perf. Sol. | Description of Performance Solutions                                                                                                                  | DtS Provisions                       | Perform. Req's   | Assess. Method |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------------------|----------------|
| 12         | Walls between the sprinklered and non-sprinklered parts are provided with glazed sections that are not protected against fire spread                  | S17C3(a) of Spec. 5 and E1D4(b)      | C1P2(1)(d), E1P4 | A2G2(2)(b)(ii) |
| 13         | After-hours, the make-up air velocity through the Timezone and JB Hi-Fi shopfront openings is increased up to 3.5 m/s in lieu of a maximum 2.5 m/s    | S21C6(2) of Spec. 21 and E2D15(2)(a) | E2P2             | A2G2(2)(b)(ii) |
| 14         | The existing smoke exhaust fans located in the Myer retail mall and Plaza generate noise levels up to 90 dB in lieu of a maximum noise level of 80 dB | Cl. 4.6 of AS 1668.1                 | E2P2             | A2G2(2)(b)(ii) |

*Table 12: Performance Solutions, relevant BCA provisions and the assessment methods*

## 9. Fire Safety Strategy

Please note that this Fire Safety Strategy may be refined and/or modified in parts to reflect the outcomes of smoke modelling. This shall not be considered the final version of the Fire Safety Strategy.

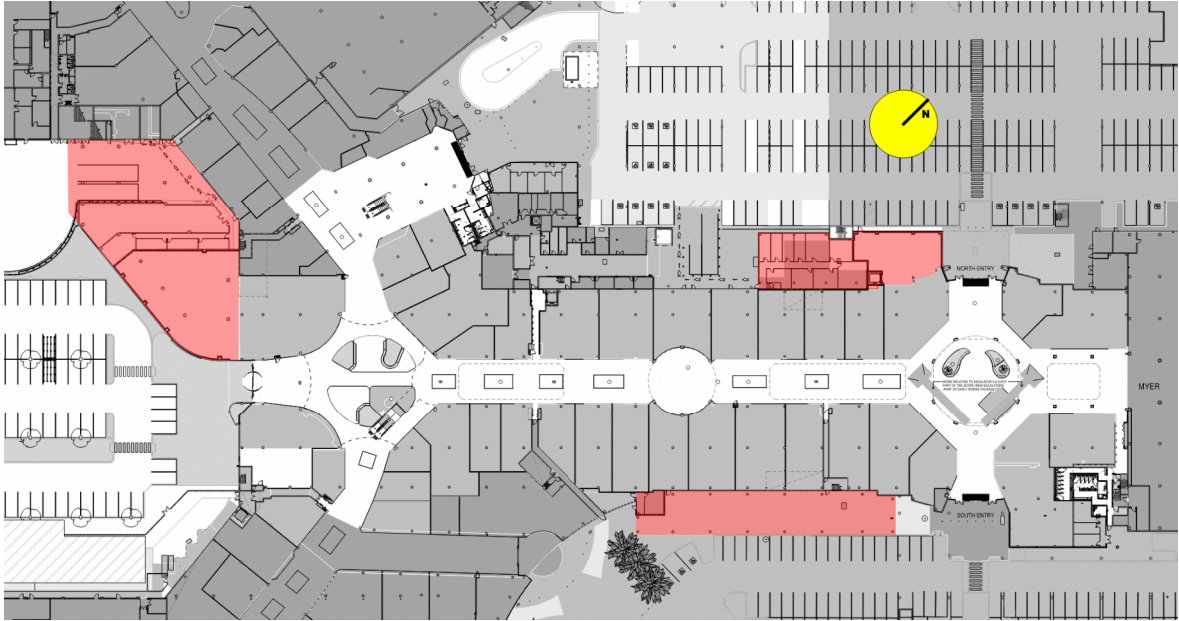
### 9.1 General

1. The redevelopment of Galleria Shopping Centre (GSC) located at 284 Collier Road, Morley WA 6062, shall comply with the “Deemed-to-Satisfy” (DtS) Provisions of the National Construction Code Volume One (NCC), Building Code of Australia 2022 (BCA), except for the specific deviations from the BCA DtS identified in Section 8.
2. The fire safety strategy for the GSC outside of the area affected by the redevelopment works shall comply with the provisions of the building codes current at the time of construction of these parts.
3. Should a change in use or building alterations and/or additions occur in the future, a reassessment will be needed to verify consistency with the analysis contained within this report.
4. The requirements listed in this Section are *safety measures* and shall be maintained as per Regulation 48A of the Building Regulations 2012 (with amendments).

### 9.2 Fire Resistance and Stability, Compartmentation and Separation, Protection of Openings

5. The parts of the GSC within the scope of this project have been assessed by the building surveyor as a 2-storey high mixed-use development of Type B construction containing Class 6 (retail) and Class 7a (open-deck carpark) parts. The Class 9b (cinemas) part is not within the scope of this project and is specifically excluded from the scope of this Fire Safety Strategy.
6. Fire resistance and stability, compartmentation and separation, and protection of openings provisions within the scope of this project shall comply with the DtS provisions of BCA Part C2, Part C3 and Part C4, except:
  - a. The loadbearing lift shaft in Tenancy 1-165 may achieve FRL 120/120/120 in lieu of FRL 180/120/120.
  - b. The loadbearing columns and walls that support the First Floor slab may achieve FRL 120/--/-- in lieu of FRL 180/--/--.
  - c. MSSBs that support the operation of smoke exhaust fans in smoke zones SZ-02 and SZ-03 may be located outside fire-rated enclosures and may be located in plant rooms that do not achieve DtS compliant fire-separation from the rest of the building
  - d. Electrical and mechanical services penetrations through the fire-rated walls of the plant rooms that contain smoke control plant may not be fire-stopped.
7. Areas where the FRL of the loadbearing structure is reduced to nominal 2 hours are highlighted red in Figure 9 below.





*Figure 9: Ground Floor areas where load bearing structure has performance-based reduced FRL*

8. The existing Myer tenancy is fire separated from the rest of the centre with fire walls and the openings to the Myer mall are protected with sliding fire doors. This existing condition shall remain unaltered.
9. The existing Kmart tenancy, Coles tenancy, Woolworths tenancy, Target tenancy and the Cinemas, except for the shopfronts, are smoke separated from the rest of the centre. This existing condition shall remain unaltered.
10. The new Timezone (tenancy 1-141) and JB Hi-Fi (tenancy 1-138) that are provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke (refer to Figure 10 where the smoke-proof walls are highlighted with solid blue lines). The shopfront openings and external walls of these tenancies do not need to prevent the free passage of smoke.
11. The modified Rebel tenancy (MM-004) that is provided with automatic smoke exhaust shall be separated from the rest of the centre with walls that shall prevent the free passage of smoke (refer to Figure 11 below where the smoke-proof walls are highlighted with solid blue lines). The shopfront opening and external walls of this tenancy do not need to prevent the free passage of smoke.
12. Smoke dampers need not be provided where ducts penetrate intertenancy walls that shall prevent the free passage of smoke, as nominated in items 10 and 11 above.
13. The new required non-fire-isolated stairwell adjacent to external balcony 1.BO.03 shall be bound with walls that shall prevent the free passage of smoke (refer to Figure 12 and Figure 13 below where the smoke-proof walls are highlighted with solid blue lines).

Client: Vicinity Centres  
Doc No.: 240380\_FEB, Rev. F  
Doc Title: Fire Engineering Brief

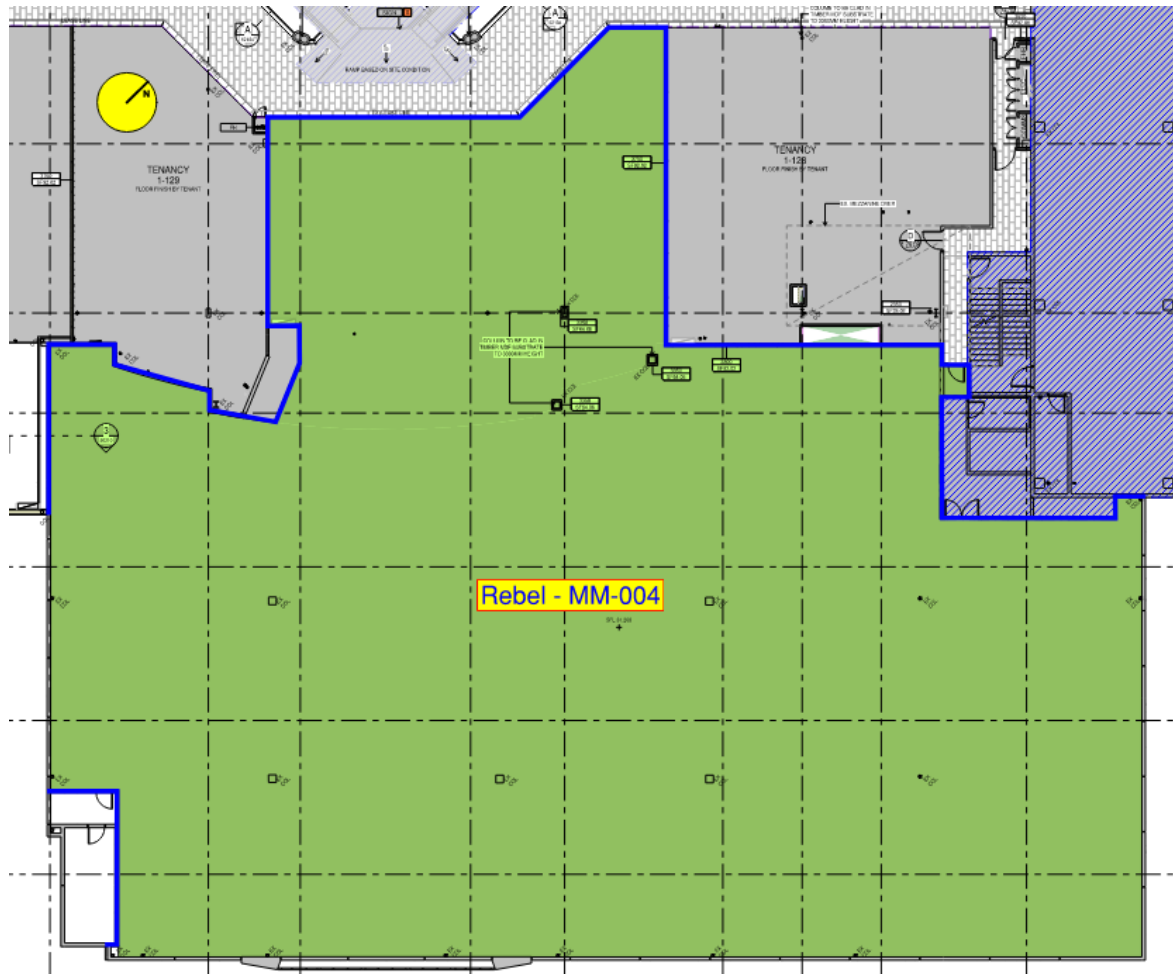


Figure 11: Walls that shall prevent the free passage of smoke around Rebel

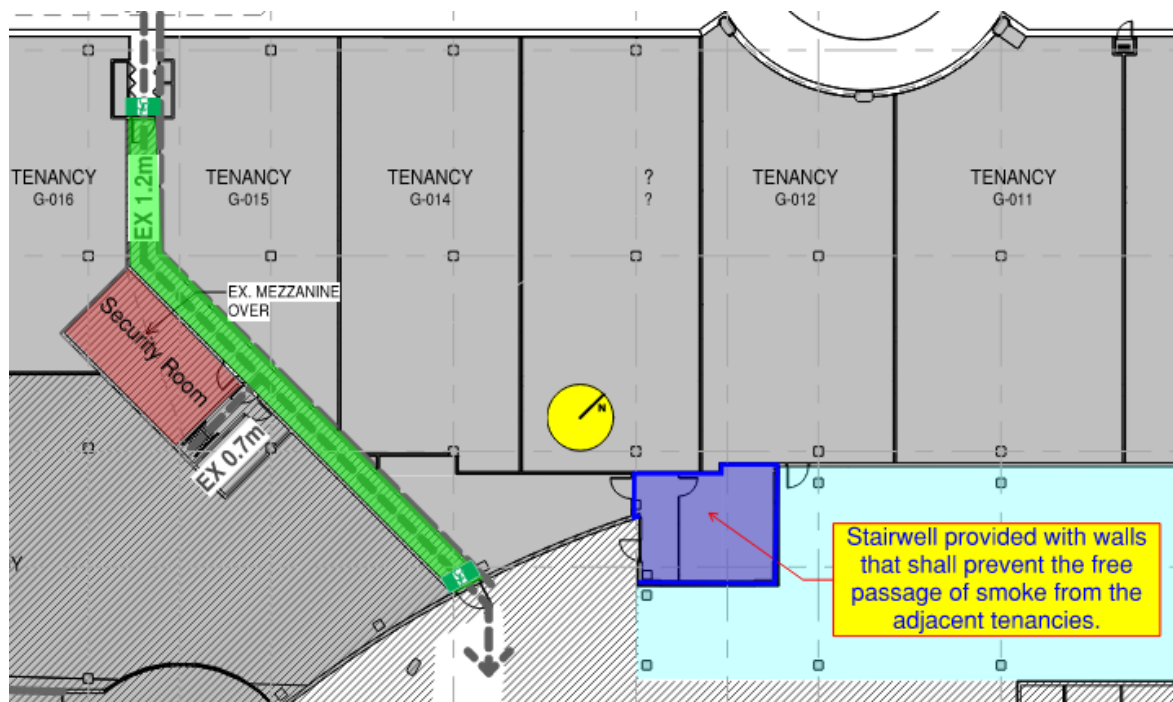


Figure 12: Walls that shall prevent the free passage of smoke on Ground Floor



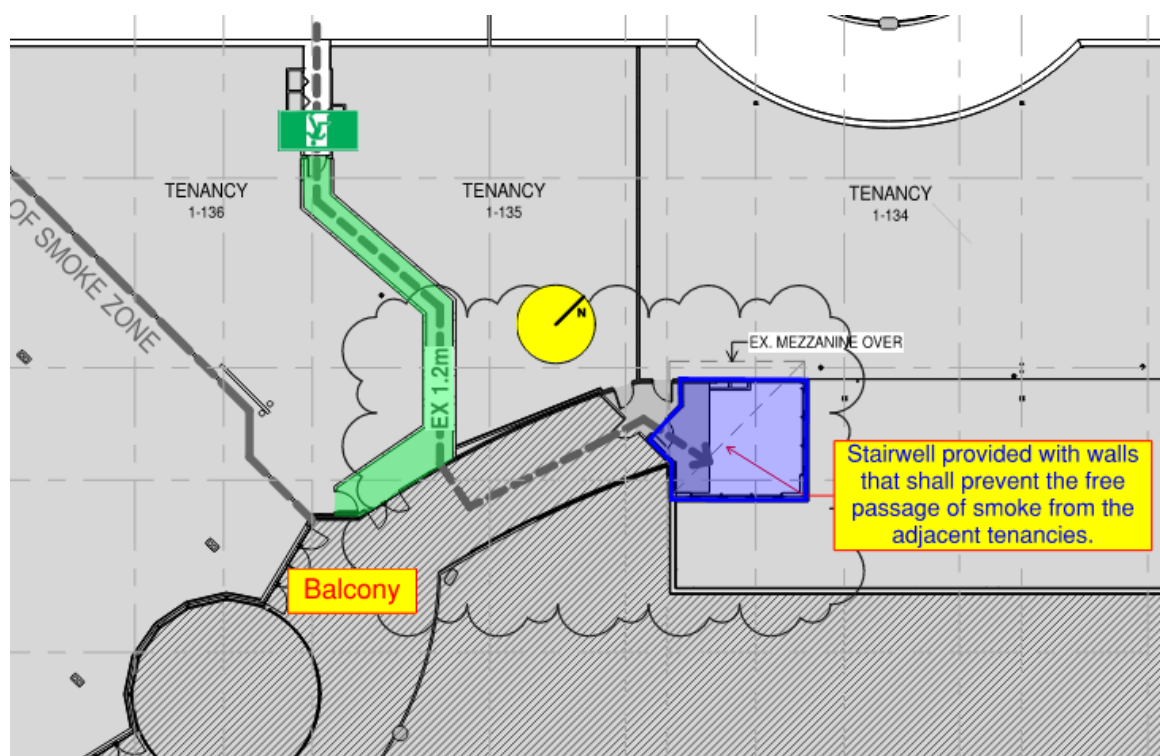


Figure 13: Walls that shall prevent the free passage of smoke on First Floor

14. The walls that shall prevent the free passage of smoke may be penetrated by services and ducts. While the penetrations around the services and ducts shall be smoke-sealed, the ducts need not be provided with smoke dampers.
15. External façades within the scope of this project (including any insulation materials and vapour membranes) shall be non-combustible materials when tested to AS 1530.1-2014.

### 9.3 Provisions for Escape, Construction of Exits

16. Travel distances within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:
  - a. Travel distances for the non-fire-isolated exits may be measured to the doors that discharge from the Class 6 parts of the GSC into covered carparks or into open spaces from where occupants need to travel either via covered carparks or under a roofed area in lieu of directly to a road or open space.
  - b. Travel distances from some specialty shops to a point of choice may be extended up to 30 m in lieu of 20 m.
  - c. Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m.
  - d. Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m.
  - e. Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m.

- f. Travel distances from FF amenities to a point of choice may be extended up to 27 m in lieu of 20 m.
  - g. Travel distances from the GF BoH area to the nearest of the alternative exits may be extended up to 50 m.
  - h. Travel distances to the nearest of the alternative exits in areas prescribed to be provided with automatic smoke exhaust may be extended up to 61 m in lieu of 40 m.
  - i. Distance between the alternative exits, when measured through a point of choice in areas prescribed to be provided with automatic smoke exhaust, may be extended up to 118 m in lieu of 60 m.
17. Other egress provisions within the scope of this project shall comply with the DtS provisions of BCA Part D2 and Part D3, except:
- a. The existing security room that does not occupy the whole of a storey may open directly into the Ground Floor fire-isolated corridor 03 (G.BO.03).
  - b. First floor fire-isolated corridor 19 (1.BO.19) may discharge to an external balcony (1.BO.03) in lieu of to a road or open space.
  - c. Existing fire-isolated corridor 06 (G.BO.06) and fire-isolated Stair A1 (EX.ST.A1) that facilitates evacuation from fire-isolated corridor 15 (1.BO.15) on First Floor and fire-isolated corridor 20 (G.BO.20) may discharge into the new Ground Floor loading dock 04 (G-LD.04) that is open for less than 2/3 of its perimeter and the paths of travel from the points of discharge from the corridors are located more than 20 m from the open space.
18. Tenancies within the scope of this project where travel distances to a point of choice exceed 30 m shall be provided with an alternative exit.
19. Existing door (circled red in Figure 14) shall unlock upon fire alarm activation in loading dock 04 fire alarm zones (FAZ-03 and FAZ-04) to facilitate occupant evacuation via the existing fire-isolated corridor 06 (G.BO.06).

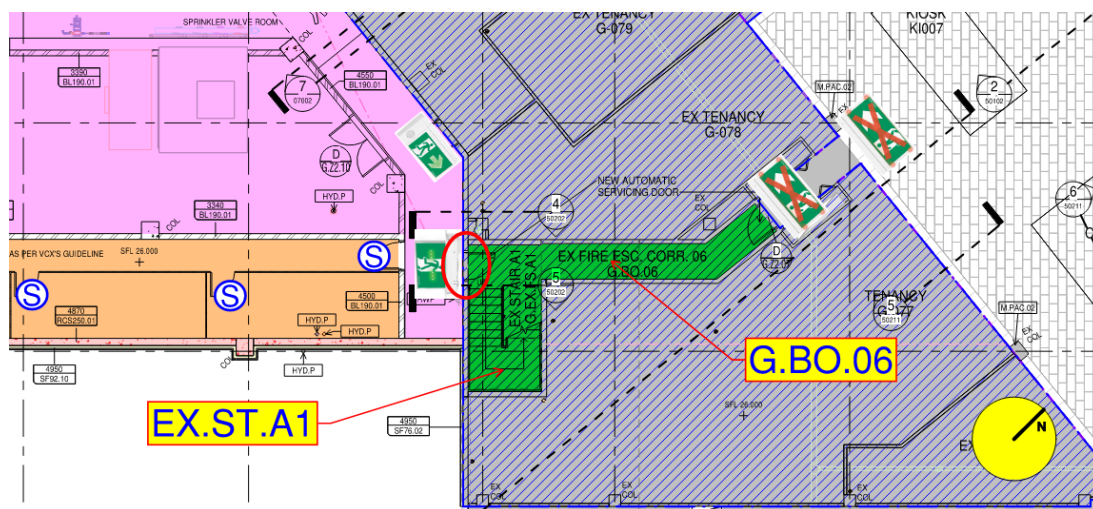


Figure 14: Door to unlock upon fire alarm activation in loading dock 04 fire alarm zone





24. Doors opening from the required exits into areas where they can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) shall be protected with bollards in accordance with Clause D2D15(1) of the BCA.
25. Egress from the existing fire-isolated Stair A2 (G.EX.FS.A2) directly to the outside at Ground Floor shall be retained.

26. Paths of travel from the point of discharge from the required exits to a road or open space shall be unobstructed and shall comply with Clause D2D15(2) of the BCA. Where paths of travel can be blocked by parked vehicles or other obstructions (garbage bins, skips, etc.) they shall be protected with appropriate barriers all the way to the point of discharge to a road or open space.

#### 9.4 Fire Fighting Equipment

27. The existing fire hydrant system within the scope of this project shall be extended to include new internal fire hydrants. The system shall comply with the DtS provisions of BCA Clause E1D2(2) and AS 2419.1-2021, except:
- a. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m.
  - b. Fire hose coverage may be achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m.
  - c. Fire hose coverage may be achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m.
  - d. Internal fire hydrants need not be located in every fire-isolated exit.
  - e. Internal fire hydrants installed in retail malls may be provided more than 4 m from required exits.
28. Fire hose reels may be omitted from the refurbished and extended parts of the centre as highlighted pink (refurbished areas) and cyan (extended areas) in Figure 16 and Figure 17 below.



Figure 16: Areas on Ground Floor where hose reels may be omitted

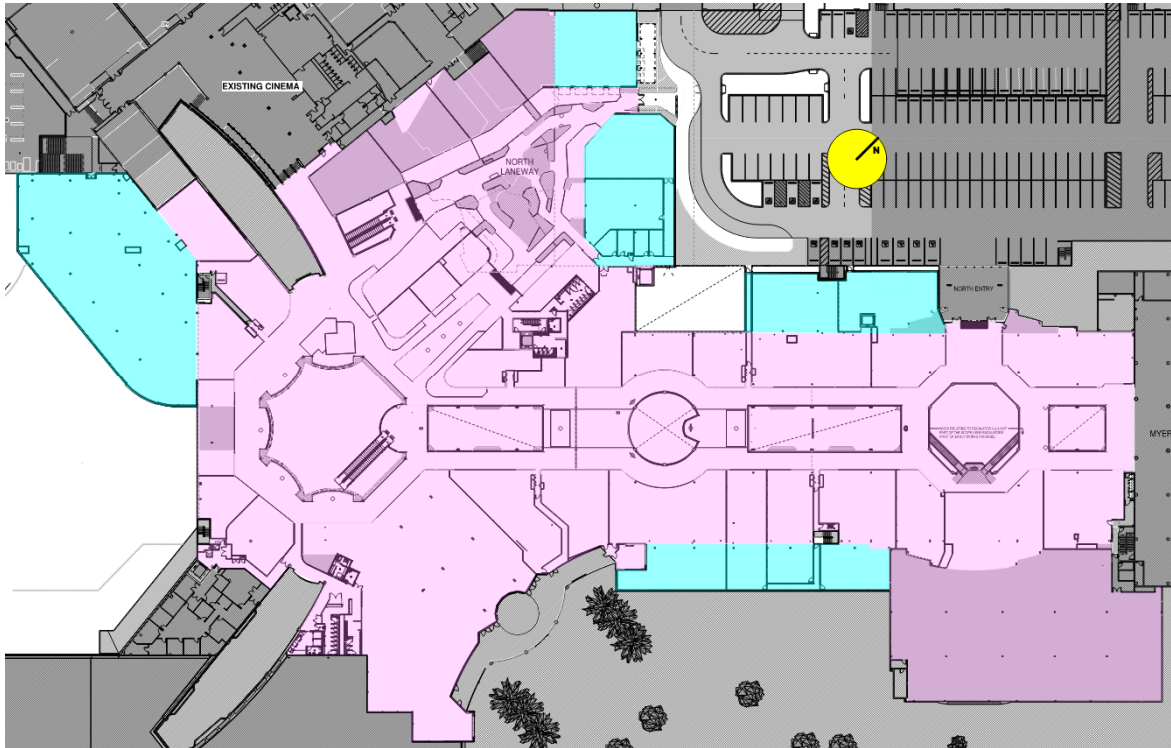


Figure 17: Areas on First Floor where hose reels may be omitted

29. The existing automatic fire sprinkler system within the scope of this project shall be modified and/or expanded where required, and shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017, except:

- a. Sprinklers may be omitted from the skylights above the Plaza and Myer retail mall (the areas highlighted red in Figure 18).

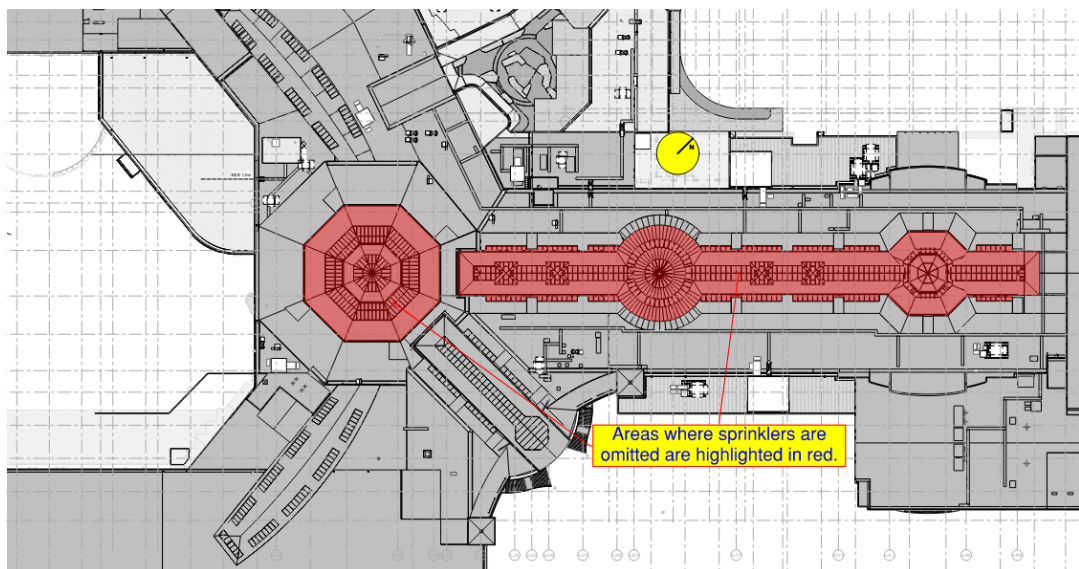
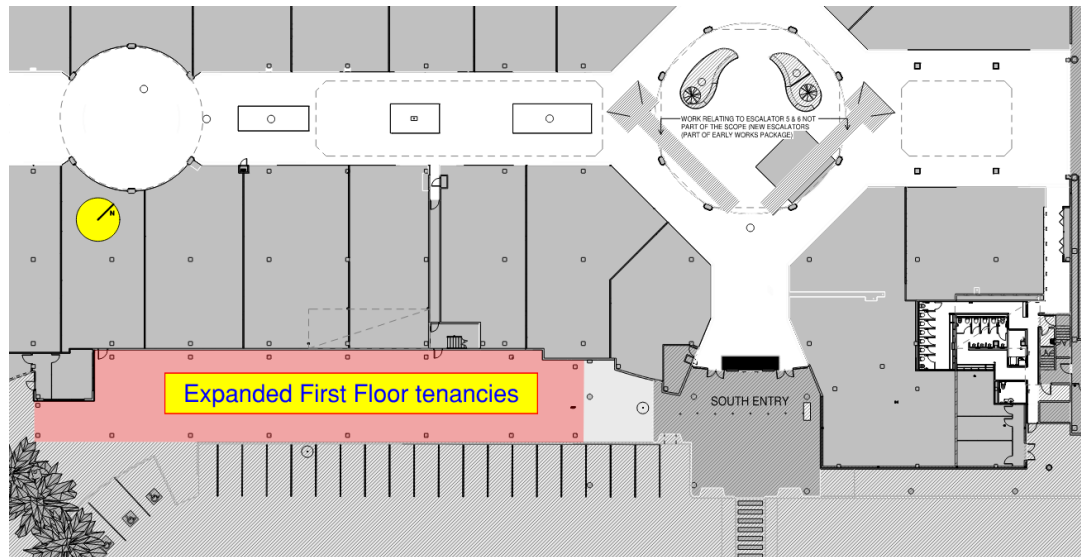


Figure 18: Omission of sprinkler protection from Plaza and Myer mall skylights

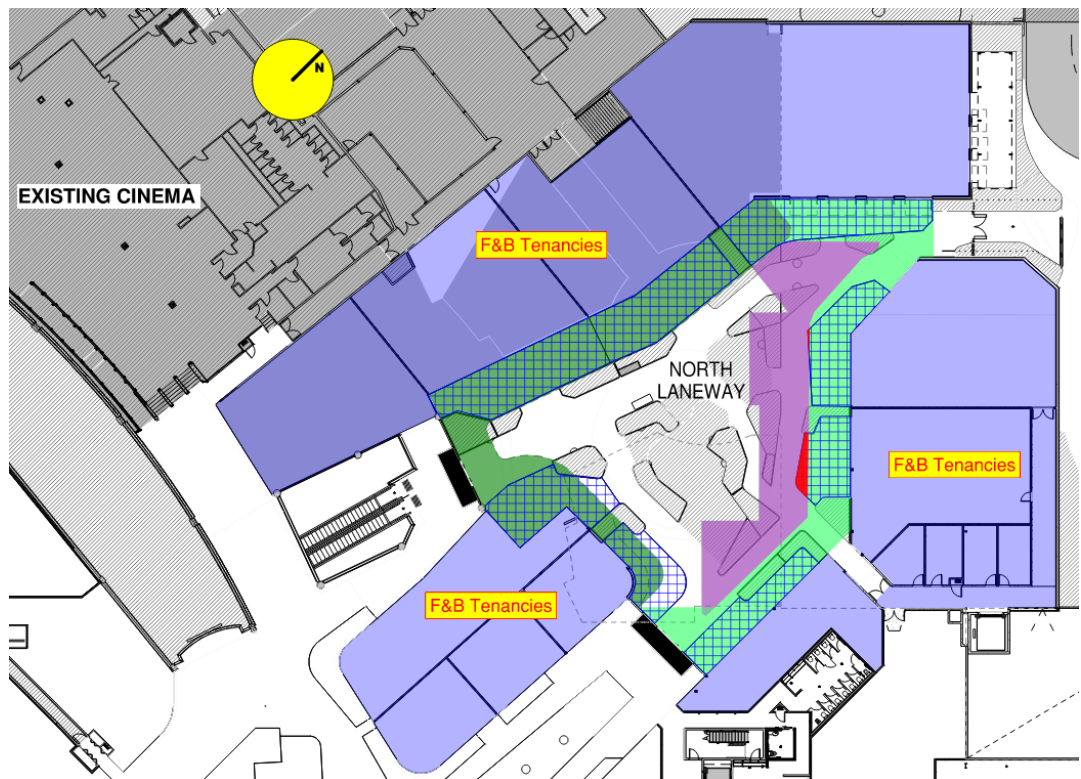
- b. Sprinklers may be omitted from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (the area highlighted red in Figure 19 below).





*Figure 19: Omission of sprinkler protection below new extended tenancies on First Floor*

- c. The eastern canopies in the North Laneway (the canopies highlighted light green in Figure 20 below) may be protected with a single row of vertical sidewall sprinklers installed along the external walls of the tenancies in lieu of 2 rows of sidewall sprinklers for canopies that are between 3.7 m and 7.4 m wide and a combination of sidewall sprinklers and conventional sprinklers in the middle of the canopies for canopies that are between 7.4 m and 9.0 m wide.



*Figure 20: North Laneway layout and extent of sprinkler protection to canopies*

- d. Walls between the sprinklered and non-sprinklered parts may be provided with glazed sections that are not protected against fire spread (the glazed sections of the walls are clouded red in Figure 21).

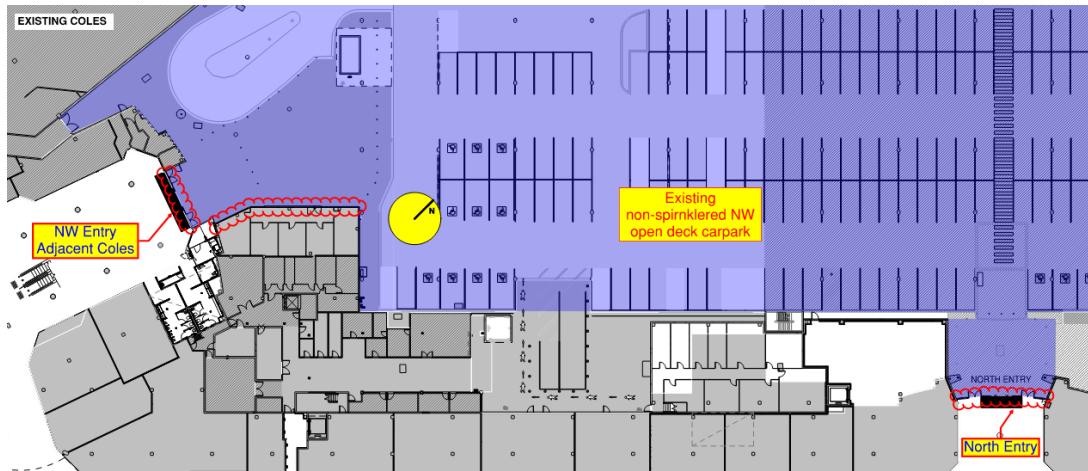


Figure 21: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections

30. Additional to item 29, to achieve an appropriate level of fire safety, sprinkler protection shall be extended into the existing Stair M6 (G.ST.M6) located between Rebel (MM-004) and Myer that is no longer considered a fire-isolated stair and into the existing stair located north of passenger lift PL.02. Stair M6 is highlighted cyan in Figure 22 and Figure 23 below. The existing stair is highlighted cyan in Figure 22 and Figure 23 below. The extended sprinkler system shall comply with the DtS provisions of BCA Clause E1D4, Specification 17 and AS 2118.1-2017.

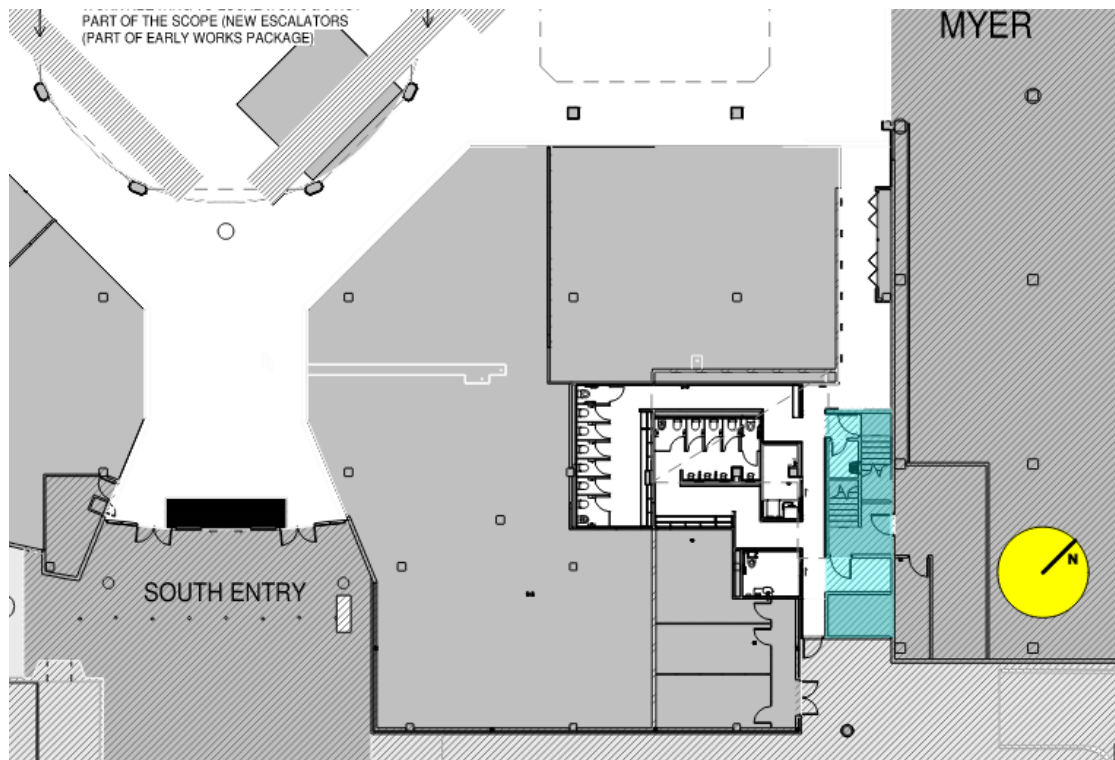


Figure 22: Stair M6 – Ground Floor



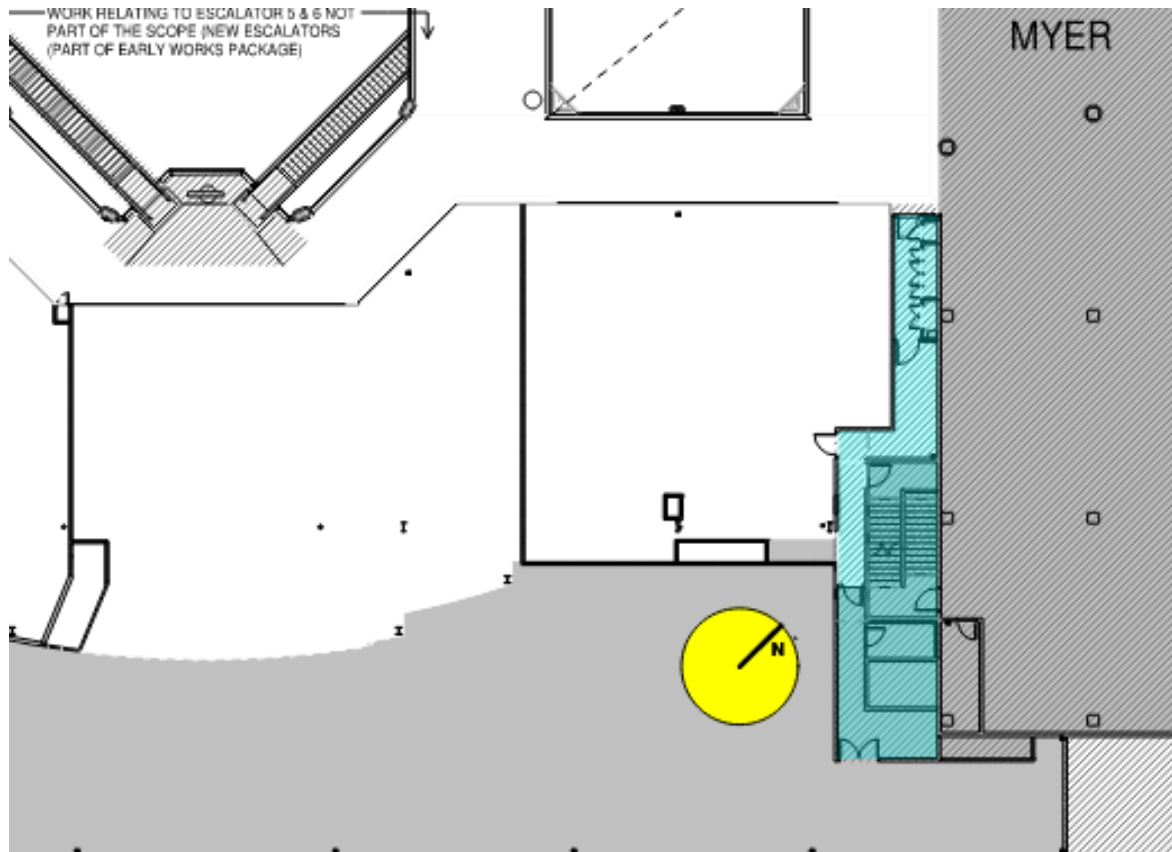


Figure 23: Stair M6 – First Floor

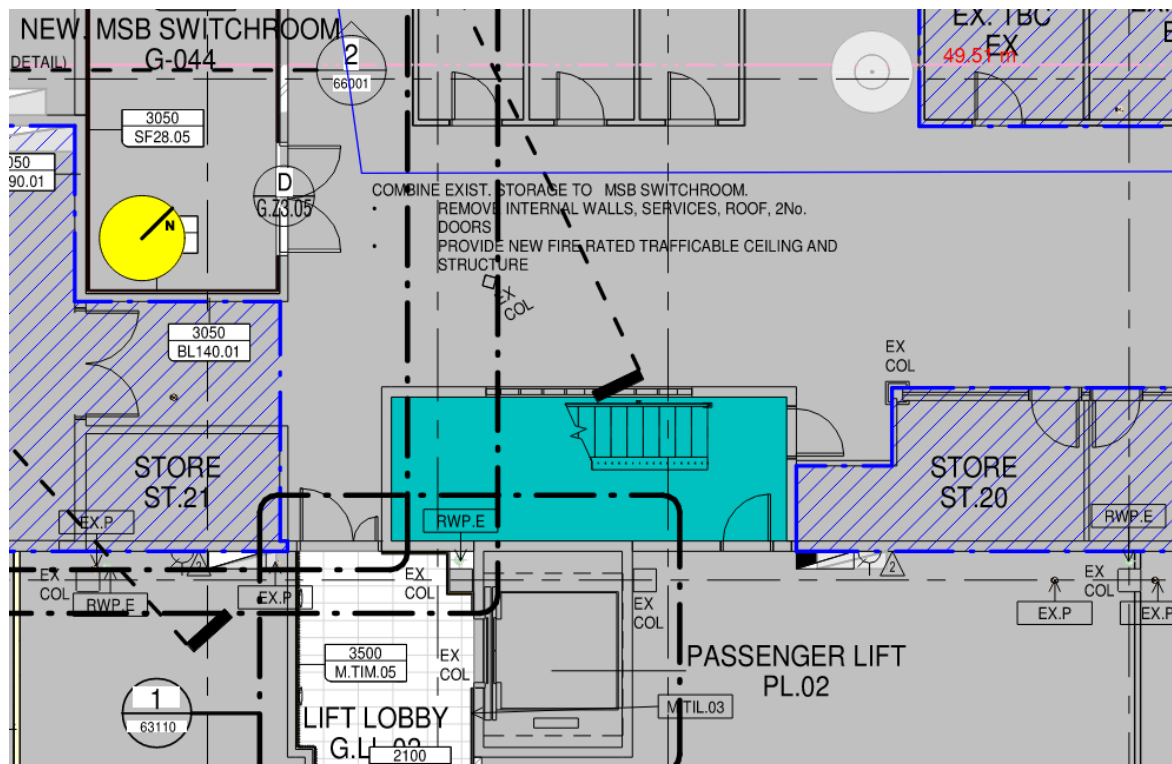


Figure 24: Existing stair north of passenger lift PL.02 – Ground Floor

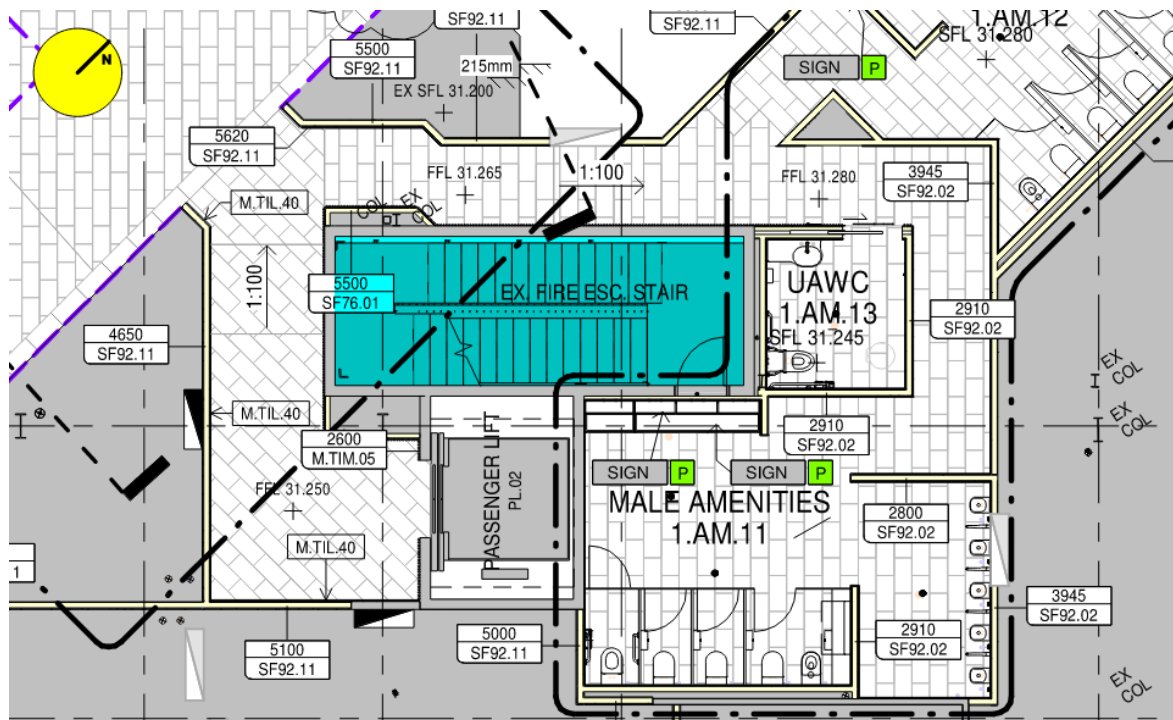


Figure 25: Existing stair north of passenger lift PL.02 – First Floor

31. The fire sprinkler heads within the scope of this project shall:
  - a. All below ceiling sprinkler heads shall be fast response, i.e. the sprinkler Response Time Index (RTI) shall not exceed  $50 \text{ ms}^{-1/2}$  and the conduction factor shall not exceed  $0.65 \text{ m/s}^{-1/2}$ .
  - b. The temperature rating of sprinkler heads shall be  $68^{\circ}\text{C}$  for below ceiling sprinklers throughout the retail and BoH areas.
  - c. The temperature rating of the sprinkler heads shall be  $93^{\circ}\text{C}$  for sprinkler heads located under uninsulated roofing and in loading docks and BoH areas that are not enclosed with external walls and where temperatures in excess of  $40^{\circ}\text{C}$  could occur in summer.
32. Vertical sidewall sprinklers shall be Reliable Model F1 or F1FR or similar sprinklers that at 207 kPa (30 PSI) pressure can protect an area up to 5.7 m (19 feet) wide.
33. Portable fire extinguishers (PFEs) suitable for Class AB(E) fire risks shall be provided within the scope of this project in accordance with BCA Clause E1D14 and the applicable parts of AS 2444-2001, where required.
34. Additional to Item 32, PFEs shall be provided in lieu of fire hose reels in accordance with Table 4.1 of AS 2444-2001 and the following:
  - a. Each PFE shall be 4.5 kg agent capacity ABE PFE (rating 6A) and may protect up to  $675 \text{ m}^2$ .
  - b. The travel distance from the most remote point on the floor to the nearest PFE shall not exceed 30 m.

- c. Each specialty tenancy shall be provided with at least one PFE.
- d. Where combustible kiosks and/or displays (including vehicle displays) are provided under voids in the Plaza and Myer retail mall, at least one 2.5 kg agent capacity ABE PFE (rating 4A) shall be provided in each kiosk or at each display to facilitate the initial attack on the fire.

## 9.5 Smoke Hazard Management

35. Within the scope of this project, to enhance the detection time and facilitate safe occupant evacuation, a fire detection and alarm system in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 shall be provided in the areas identified below. The below ceiling smoke detectors shall be installed on a 10 m x 10 m nominal grid and smoke detectors in the concealed space shall be installed in accordance with the provisions of AS 1670.1-2018 (except where specifically modified by the provisions of item 37 below). The below ceiling heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018 where provision of smoke detectors could cause spurious alarms.

- a. Throughout specialty shops and mini-major not provided with automatic smoke exhaust.
- b. Throughout enclosed BoH areas and loading docks.

36. Additional to item 35, specific fire alarm zones shall be created to facilitate safe occupant evacuation. The specific alarm zones are summarised in Table 13 below and the extent of these zones is shown in Figure 27, Figure 28 and Figure 30 in Section 9.9.

| Fire alarm zones associated with dynamic exit signs                                                            | Detection mechanism |
|----------------------------------------------------------------------------------------------------------------|---------------------|
| Fire alarm zone 01 (FAZ-01) – Existing western BoH – areas highlighted orange in Figure 27 in Section 9.9      | Smoke detectors     |
| Fire alarm zone 02 (FAZ-02) – Existing western BoH – areas highlighted pink in Figure 27 in Section 9.9        | Heat detectors      |
| Fire alarm zone 03 (FAZ-03) – Loading Dock 04 – areas highlighted orange in Figure 28 in Section 9.9           | Smoke detectors     |
| Fire alarm zone 04 (FAZ-04) – Loading Dock 04 – areas highlighted pink in Figure 28 in Section 9.9             | Heat detectors      |
| Fire alarm zone 05 (FAZ-05) – Tenancies 1-134 and 1-135 – areas highlighted orange in Figure 30 in Section 9.9 | Smoke detectors     |

Table 13: Specific fire alarm zones

37. In fire alarm zones FAZ-01 and FAZ-03 smoke detectors in the BoH areas only need to be installed not more than 1.5 m horizontally from the doorway opening into the external circulation spaces. The approximate locations of smoke detector are marked with 'S' symbols in Figure 27 and Figure 28 in Section 9.9.

38. In fire alarm zones FAZ-01 and FAZ-05 smoke detectors in tenancies G-055, G-118, 1-134 and 1-135 shall be installed on a 10 m x 10 m nominal grid in accordance with the provisions of AS 1670.1-2018.
39. In fire alarm zones FAZ-02 and FAZ-04 heat detectors shall be installed on a 7 m x 7 m nominal grid in accordance with the provisions of AS 1670.1-2018.
40. A fire detection and alarm system in accordance with Clause S20C6(3) of BCA Specification 21 shall be provided throughout the following areas:
  - a. Rebel tenancy (MM-004).
  - b. JB Hi-Fi (tenancy 1-138).
  - c. Timezone (tenancy 1-141).
  - d. Myer retail mall & Plaza.
41. The automatic fire sprinkler system and fire detection and alarm systems shall be interfaced with the Fire Brigade Panel (FDCIE) and shall be linked to DFES via the Direct Brigade Alarm (DBA) provided in accordance with Clause S20C8 of BCA Specification 20.

#### 9.6 Smoke Exhaust in Mini-major Tenancies

42. Automatic smoke exhaust systems in accordance with BCA Clause E2D15 and Specification 21 shall be provided in Timezone (SZ-06), JB Hi-Fi (SZ-07) and Rebel (SZ-08), as shown in Figure 26 below, except:
  - a. The make-up air velocity through the Timezone and JB Hi-Fi shopfront openings after-hours may be increased up to 3.5 m/s in lieu of a maximum 2.5 m/s prescribed by Clause S21C6(2).

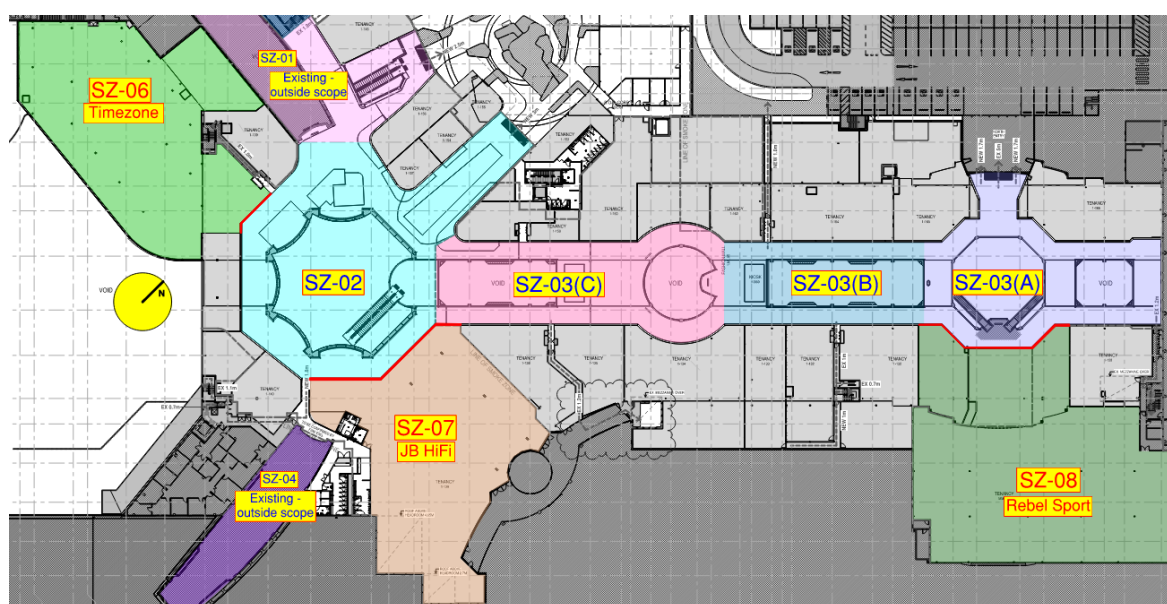


Figure 26: Smoke zones – First Floor

43. The smoke exhaust systems in the tenancies nominated in item 42 above shall activate only if smoke is detected in the tenancy first. The smoke exhaust system in the tenancy shall not activate if smoke is detected in the retail mall first and then spreads and activates smoke detection in the tenancy. Similarly, smoke exhaust in the retail malls shall not activate if smoke is detected in a tenancy nominated in item 42 above and then spreads and activates smoke detection in the retail mall.
44. Make-up air to the smoke exhaust systems nominated in item 42 above shall be provided from the retail malls via the shopfront openings (the characteristics of the make-up air are nominated in Section 9.8 below). The configuration of the shopfront openings shall be as follows:
- During trading hours, the roller-shutter(s) in the shopfront shall descend to 2.4 m above floor level upon activation of the smoke detection system installed in the tenancy to create smoke baffles between the tenancy and the retail mall. The bottom section of the roller-shutters (between the bottom of the baffle and the underside of the bulkhead above) shall be solid. The make-up air velocity through the shopfront opening shall not exceed 2.5 m/s.
  - After-hours, the roller-shutter(s) in the shopfront shall remain closed upon activation of the smoke detection system installed in the tenancy. The roller-shutters shall be provided with openings that shall not extend beyond 2.4 m above floor level. The net free open area of the openings shall be such that the make-up velocity does not exceed 2.5 m/s for the Rebel shopfront and 3.5 m/s for the Timezone and JB-Hi Fi shopfronts.

## 9.7 Smoke Exhaust in Retail Malls

45. The Plaza (SZ-02) and Myer mall (SZ-03(A), SZ-03(B) and SZ-03(C)) within the scope of this project and the Coles link mall (SZ-01) and the Target link mall (SZ-04) outside the scope of this project are provided with existing smoke exhaust systems. The smoke exhaust fans (SEF) and the design and actual SEF capacities for each smoke zone are summarised in Table 14.

| Smoke zone | Smoke Exhaust Fans                     | Design SEF capacity, l/s | Actual SEF capacity, l/s |
|------------|----------------------------------------|--------------------------|--------------------------|
| SZ-01      | SEF 13.2; SEF 13.3; SEF 13.4; SEF 13.5 | 64,000                   | 48,352                   |
| SZ-02      | SEF 13.1; SEF 17.6; SEF 21.5           | 69,000                   | 63,069                   |
| SZ-03(A)   | SEF 10.2; SEF 19.2                     | 46,000                   | 50,681                   |
| SZ-03(B)   | SEF 15.1; SEF 16.2                     | 46,000                   | 51,853                   |
| SZ-03(C)   | SEF 12.1; SEF 12.2                     | 46,000                   | 50,238                   |
| SZ-04      | SEF 21.1; SEF 21.2; SEF 21.3; SEF 21.4 | 64,000                   | 31,613                   |

Table 14: Smoke zones and smoke exhaust capacity per each zone



46. Even though smoke zones SZ-01 and SZ-04 are outside the scope of this project, they are referenced because smoke from SZ-02 may spread to these smoke zones. Without accounting for an adequate volume of make-up air, the effective operation of the smoke exhaust systems in the affected smoke exhaust zones may not be achieved.
47. The configuration of the existing smoke exhaust zones, should remain unchanged; however, the following deviations from the DtS provisions of Clause E2D15(2)(a) and BCA Specification 21 are addressed within the scope of this project:
  - a. Smoke exhaust rates in Plaza and Myer mall smoke exhaust zones may be determined on a performance basis in lieu of compliance with the BCA DtS provisions.
  - b. The horizontal length of the Myer retail mall smoke reservoir may be extended up to 144 m long in lieu of 60 m.
  - c. The horizontal length of the Plaza smoke reservoir may be extended up to 66 m long in lieu of 60 m.
48. Power supply to the smoke exhaust fans in smoke zones SZ-01 (Coles link mall) and SZ-04 (Target link mall) shall comply in full with the BCA DtS provisions.
49. The existing smoke baffles throughout the retail malls shall be retained and shall be rectified where gaps have formed between the edges of the baffles and the adjacent walls.
50. Smoke baffles between smoke zone SZ-01 and SZ-02; SZ-04 and SZ-02; and SZ-02 and SZ-03(A-C) need not be provided.

## 9.8 Make-up Air Provisions

51. Make-up air to the smoke exhaust systems in the retail malls and in tenancies nominated in item 42 above shall be provided in accordance with Clause E2D15(2)(a) and BCA Specification 21, and AS 1668.1-2015, except:
  - a. Power supply to the AHUs that provide make-up air to the smoke exhaust systems may not be fire-rated.
  - b. Make-up air velocity through vertical openings may exceed 1 m/s.
52. Make-up air to the smoke exhaust systems shall be provided from AHUs nominated in Table 15 below and via the external retail mall doors that shall automatically open upon fire alarm activation (both during trading hours and after-hours), as nominated in Table 16 below.

| Plant Room                                                                                                | Air Handling Units | Design make-up air capacity, l/s |
|-----------------------------------------------------------------------------------------------------------|--------------------|----------------------------------|
| <b>Shall supply make-up air independent of where fire is detected (SZ-01, SZ-02, SZ-03(A-C) or SZ-04)</b> |                    |                                  |
| AP7                                                                                                       | AHU 7.1            | 1,250                            |
| AP Coles                                                                                                  | AHU Coles          | 15,000                           |
| <b>Sub-total:</b>                                                                                         |                    | <b>16,250</b>                    |

| Plant Room                                                                   | Air Handling Units        | Design make-up air capacity, l/s |
|------------------------------------------------------------------------------|---------------------------|----------------------------------|
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-01</b>      |                           |                                  |
| AP3                                                                          | AHU 3.2                   | 1,100                            |
| AP4                                                                          | AHU 4.1; AHU 4.2          | 10,250                           |
| AP6                                                                          | AHU 6.1                   | 4,000                            |
| AP8                                                                          | AHU 8.1                   | 8,000                            |
| AP9                                                                          | AHU 9.1                   | 7,500                            |
| AP11                                                                         | AHU 11.1                  | 3,500                            |
| <b>Sub-total:</b>                                                            |                           | <b>34,350</b>                    |
| <b>Total for smoke zone SZ-01</b>                                            |                           | <b>50,600</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-02</b>      |                           |                                  |
| AP1                                                                          | AHU 1.1                   | 5,000                            |
| AP3                                                                          | AHU 3.1                   | 2,200                            |
| AP4                                                                          | AHU 4.3                   | 6,000                            |
| AP6                                                                          | AHU 6.1                   | 4,000                            |
| AP8                                                                          | AHU 8.1                   | 8,000                            |
| AP9                                                                          | AHU 9.1                   | 7,500                            |
| AP11                                                                         | AHU 11.1                  | 3,500                            |
| <b>Sub-total:</b>                                                            |                           | <b>36,200</b>                    |
| <b>Total for smoke zone SZ-02</b>                                            |                           | <b>52,450</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-03(A-C)</b> |                           |                                  |
| AP1                                                                          | AHU 1.1                   | 5,000                            |
| AP3                                                                          | AHU 3.1; AHU 3.2          | 3,300                            |
| AP4                                                                          | AHU 4.1; AHU 4.2; AHU 4.3 | 16,250                           |
| AP6                                                                          | AHU 6.1                   | 4,000                            |
| <b>Sub-total:</b>                                                            |                           | <b>28,550</b>                    |
| <b>Total for smoke zone SZ-03</b>                                            |                           | <b>44,800</b>                    |
| <b>Shall supply make-up air if fire is detected in smoke zone SZ-04</b>      |                           |                                  |
| AP1                                                                          | AHU 1.1                   | 5,000                            |
| AP3                                                                          | AHU 3.1; AHU 3.2          | 3,300                            |
| AP4                                                                          | AHU 4.2; AHU 4.3          | 10,750                           |
| AP8                                                                          | AHU 8.1                   | 8,000                            |
| AP9                                                                          | AHU 9.1                   | 7,500                            |
| AP11                                                                         | AHU 11.1                  | 3,500                            |

| Plant Room                 | Air Handling Units | Design make-up air capacity, l/s |
|----------------------------|--------------------|----------------------------------|
| Sub-total:                 |                    | 38,050                           |
| Total for smoke zone SZ-04 |                    | 54,300                           |

Table 15: AHUs that shall provide make-up air to the smoke exhaust systems

| Door    | Location                                          | Size, m     | Net free open area, m <sup>2</sup> |
|---------|---------------------------------------------------|-------------|------------------------------------|
| D.EX.01 | South-east entrance to Woolworths and Target mall | 2.55 x 2.91 | 6.55                               |
| D.EX.02 | South-west entrance to Target link mall           | 2.45 x 2.40 | 5.16                               |
| D.EX.03 | South-west entrance to Kmart mall                 | 1.74 x 2.35 | 3.38                               |
| D.EX.04 | North-west entrance to Coles mall                 | 1.65 x 2.35 | 3.17                               |
| D.EX.05 | North-east entrance to ANZ mall                   | 3.29 x 2.41 | 7.20                               |
| D.EX.06 | North entrance to Coles mall                      | 2.06 x 2.41 | 4.24                               |
| 1.Z6.01 | South entrance to Plaza (new)                     | 2.03 x 2.45 | 4.24                               |
| G.Z4.03 | North-west entrance to Myer mall                  | 2.86 x 2.63 | 6.73                               |
| G.Z8.02 | South-east entrance to Myer mall                  | 2.35 x 2.27 | 4.65                               |
| Total:  |                                                   |             | 45.32                              |

Table 16: External doors that shall provide make-up air to the smoke exhaust system

53. AHUs nominated in Table 15 shall provide make-up air to the retail malls at Ground Floor only.
54. All AHUs that are not supplying make-up air to the fire-affected smoke zone shall shut down on fire trip.

## 9.9 Emergency Lighting, Exit Signs

55. Emergency lighting within the scope of this project shall be located and installed in accordance with Clauses E4D2, E4D3 and E4D4 of the BCA and AS/NZS 2293.1-2018.
56. Exit signs within the scope of this project shall be located and installed in accordance with Clauses E4D5 and E4D6 of the BCA and AS/NZS 2293.1-2018.
57. Additional to item 56 above, dynamic RED exit signs shall be installed above the doors nominated in Table 17, as shown in Figure 27 to Figure 30 below.

| Doors/openings provided with dynamic exit signs |                                                                                           | Fire alarm zones associated with the dynamic exit signs |
|-------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Level                                           | Doors/openings                                                                            |                                                         |
| Ground Floor                                    | Opening from the Myer retail mall leading to corridor 04 (G.BO.04) and Lift Lobby G.LL.02 | Fire alarm zone FAZ-01,<br>Fire alarm zone FAZ-02       |
|                                                 | Door leading from Lift Lobby G.LL.02 to the western BoH area                              |                                                         |

| Doors/openings provided with dynamic exit signs |                                                                                                    | Fire alarm zones associated with the dynamic exit signs |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Level                                           | Doors/openings                                                                                     |                                                         |
|                                                 | Door leading from Tenancy G-055 to the western BoH area                                            |                                                         |
|                                                 | Door leading from Tenancy G-118 to the western BoH area                                            |                                                         |
| Ground Floor                                    | Door leading from the Coles retail mall to fire-isolated corridor 06 (G.BO.06)                     | Fire alarm zone FAZ-03,<br>Fire alarm zone FAZ-04       |
|                                                 | Door leading from fire-isolated corridor 06 (G.BO.06) and Stair A1 (G.EX.FS.A1) to Loading Dock 04 |                                                         |
|                                                 | Door leading from the Coles retail mall to fire-isolated corridor 20 (G.BO.20)                     |                                                         |
| First Floor                                     | Door D.3155 leading from Plaza to fire-isolated corridor 15 (1.BO.15)                              |                                                         |
|                                                 | Door D.3957 leading from Tenancy 1-144 to fire-isolated corridor 19 (1.BO.19)                      |                                                         |
| First Floor                                     | Door leading from the Myer retail mall to fire-isolated corridor 19 (1.BO.19)                      | Fire alarm zone FAZ-05                                  |

*Table 17: Doors provided with dynamic RED exit signs and the associated fire alarm zones*

58. Additional to item 56 above, a dynamic GREEN direction exit sign (refer to Figure 32 below) with sounder shall be installed in the path of travel and a dynamic GREEN exit sign (refer to Figure 33 below) shall be installed above the door nominated in Table 18, as shown in Figure 28 below.

| Doors/openings provided with dynamic exit signs |                                                                                                                     | Fire alarm zones associated with the dynamic exit signs |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| Level                                           | Path of travel / door                                                                                               |                                                         |
| Ground Floor                                    | In path of travel from plantroom AP.ENT to door leading from loading dock 04 to fire-isolated corridor 06 (G.BO.06) | Fire alarm zone FAZ-03,<br>Fire alarm zone FAZ-04       |
|                                                 | Door leading from loading dock 04 to fire-isolated corridor 06 (G.BO.06)                                            |                                                         |

*Table 18: Door provided with dynamic GREEN exit signs and the associated fire alarm zones*

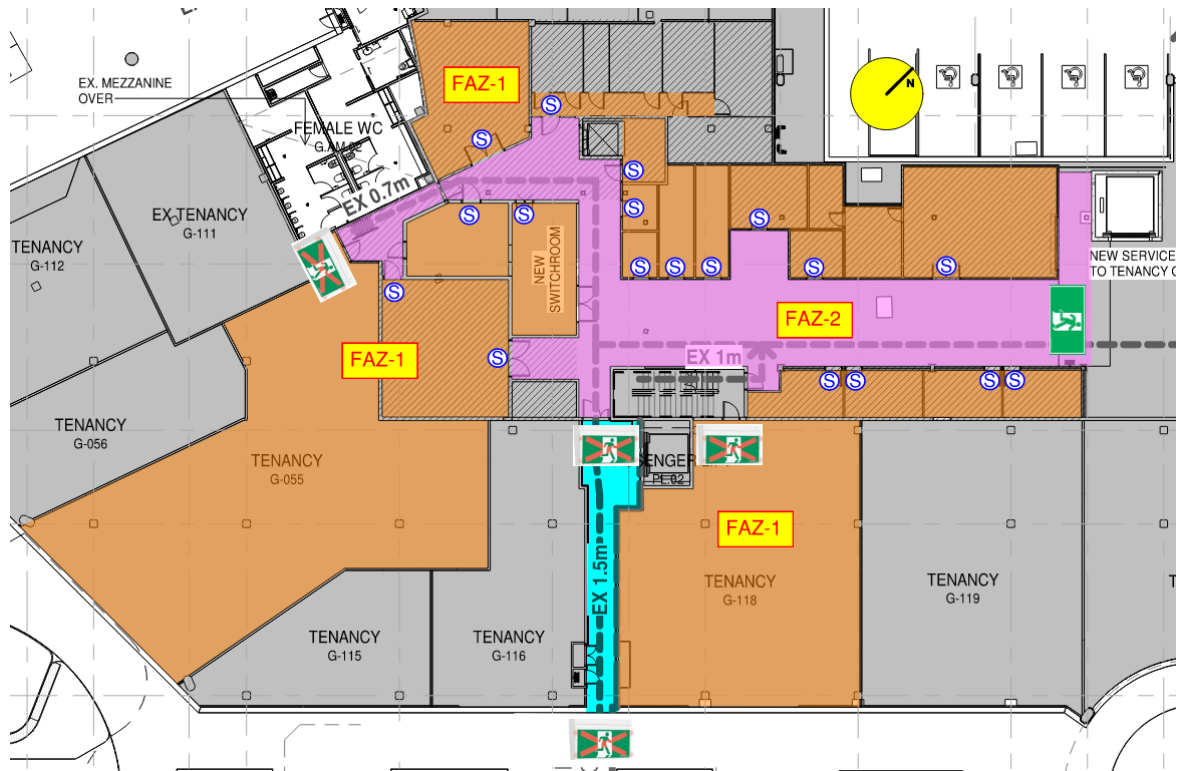


Figure 27: Location of dynamic exit signs interfaced with fire alarm zones FAZ-1 and FAZ-2

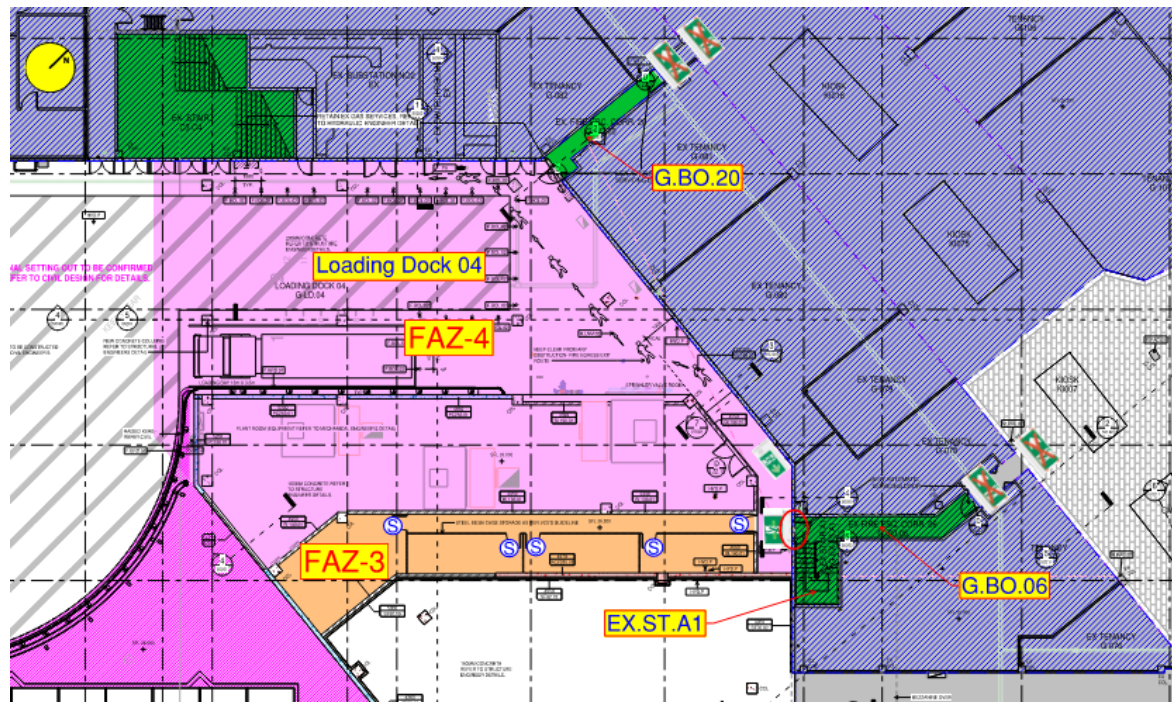


Figure 28: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – Ground Floor



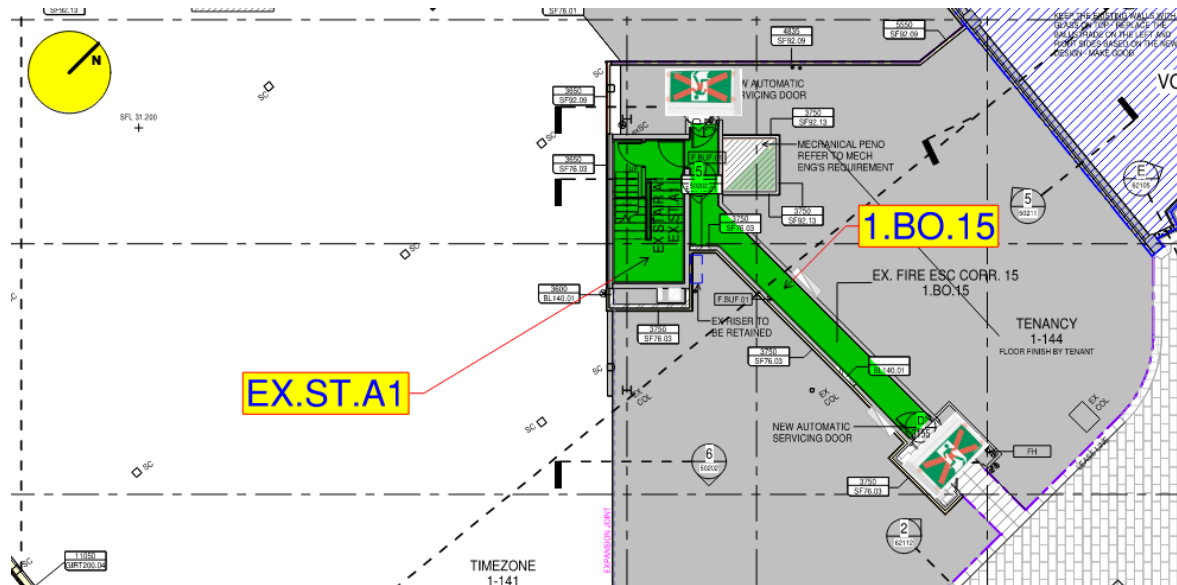


Figure 29: Location of dynamic exit signs interfaced with fire alarm zones FAZ-3 and FAZ-4 – First Floor

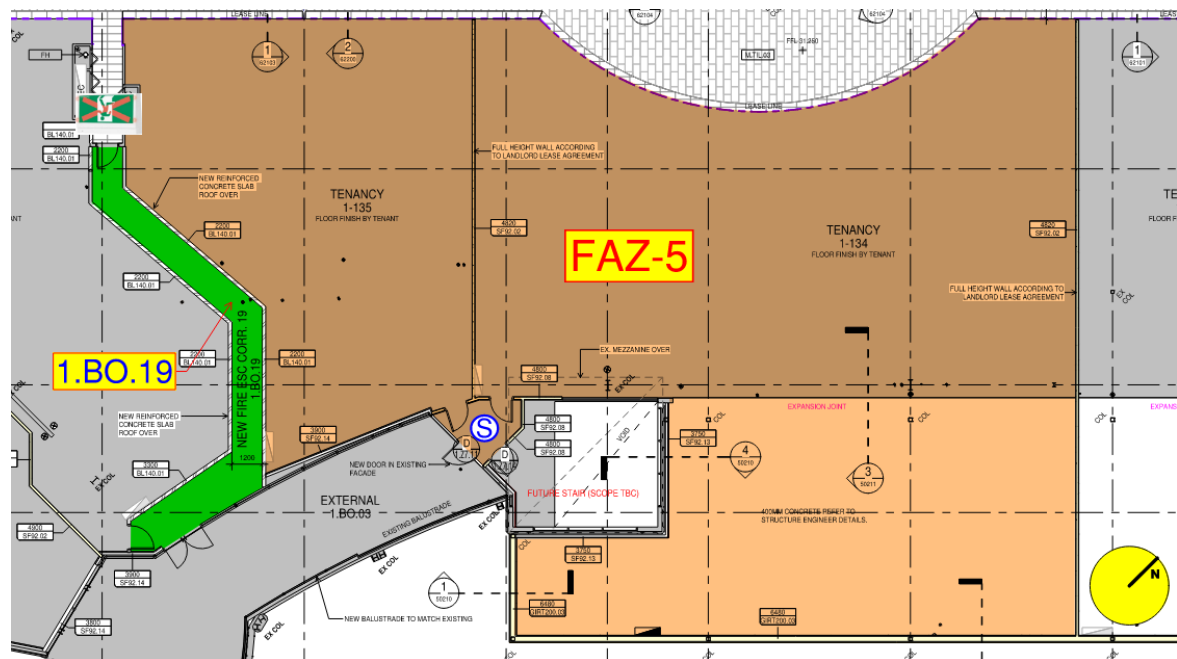


Figure 30: Location of dynamic exit signs interfaced with fire alarm zone FAZ-5

59. The dynamic RED exit signs shall be as shown in Figure 31 or similar.



*Figure 31: Dynamic RED X sign*

60. During the normal mode of operation, the dynamic RED exit signs shall show the running man pictogram. Upon fire alarm activation in a fire alarm zone, as nominated in item 36 above, the dynamic RED exit signs above the doors associated with the fire-affected fire alarm zone, as nominated in Table 17 above, shall activate and shall display a red cross.

61. The dynamic GREEN exit sign with sounder shall be as shown in Figure 32 or similar.



*Figure 32: Dynamic GREEN exit sign with sounder*

62. The dynamic GREEN exit sign shall be as shown in Figure 33 or similar.



*Figure 33: Dynamic GREEN exit sign*

63. During the normal mode of operation, the dynamic GREEN exit signs shall not be illuminated. Upon fire alarm activation in fire alarm zones FAZ-03 or FSZ-04, as nominated in item 36 above, the dynamic GREEN exit signs in the path of travel to and above the door above the door leading into fire-isolated corridor 06 (G.BO.06), shall activate and shall display running green dots. The dynamic direction exit sign with sounder shall produce a message stating: EVACUATE HERE.

64. Emergency Warning and Intercommunication System (EWIS) shall be provided throughout the areas within the scope of this project (areas highlighted pink in Figure 34 and Figure 35 below) in accordance with Clause E4D9(d) and AS 1670.4-2018. Activation of the automatic fire sprinkler system and of the smoke detection system shall activate the EWIS.
65. Addition to item 63 above, the EWIS shall be extended into the Centre Management Office (the area highlighted cyan in Figure 35 below). The extended EWIS shall be installed in accordance with Clause E4D9(d) and AS 1670.4-2018.
66. The EWIS shall be configured such that compliance with the provisions of Clause AS 1670.4-2018 is achieved in the Plaza and Myer retail malls where the noise levels generated by the existing smoke exhaust fans may be elevated.



*Figure 34: Extent of the EWIS system upgrade – Ground Floor.*

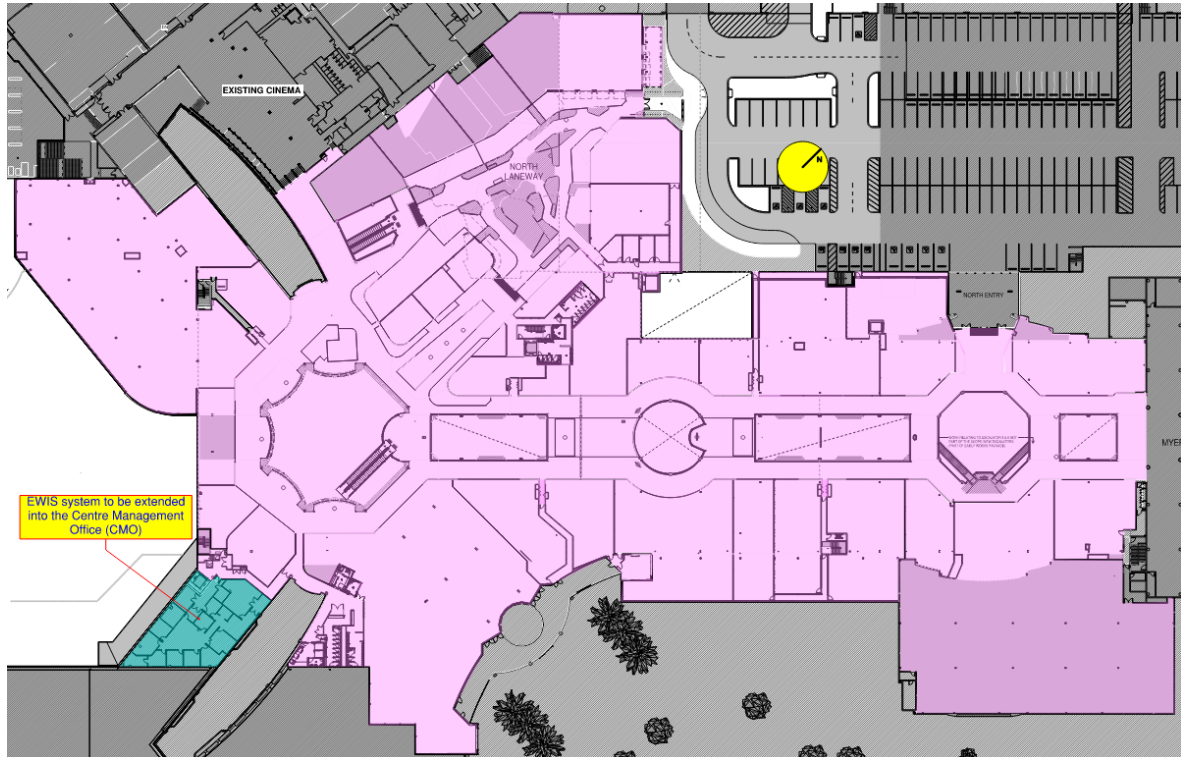


Figure 35: Extent of the EWIS system upgrade – First Floor

#### 9.10 Fire Safety Signage

67. Signage shall be provided at the fire hydrant booster assembly, at the onsite fire hydrants, at the Fire Brigade Panel (FDCIE) and on the fire hydrant system block plans. The signs shall be fade resistant.
- The sign shown in Figure 36 shall be provided at the booster assembly, at the FDCIE and on the fire hydrant system block plans.

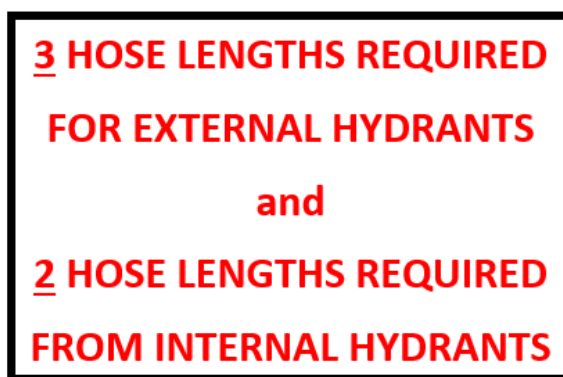


Figure 36: Extra lengths of hose sign at the booster assembly and at the FDCIE

- The sign at the booster assembly shall be in capital letters not less than 50 mm high in a colour contrasting with the background.
- The sign at the FDCIE shall be of a minimum A3 size sheet and shall be installed in a prominent location where it is immediately apparent to the responding DFES personnel.

- d. The sign on the fire hydrant system block plans shall be appropriate to the size of the block plan and shall be immediately apparent.
- e. The sign shown in Figure 37 shall be provided at the on-site external fire hydrants, including those on the open-deck carpark roof. The sign shall be in capital letters not less than 30 mm high in a colour contrasting with the background in accordance with the provisions of DFES Guideline GL-03.



*Figure 37: Sign identifying the requirement for 3 lengths of hose from external hydrants*

### 9.11 Building Subject to FSER Notice

68. A “Building Subject to FSER” notice (a copy of the notice will be provided in the FSER) shall be mounted adjacent to the FDCIE. The notice shall be of a minimum A4 size sheet, mounted within a permanent frame and securely fastened to the wall, and shall be in accordance with the DFES “Direct Brigade Alarm (DBA) Technical Bulletin – July 2014 (Advice 4)” and DFES DBA Connection Code. The notice shall be black lettering on a white background and shall meet the following minimum requirements for size:

- a. BUILDING SUBJECT TO FSER – Times New Roman – 15 mm high capital letters.
- b. Body of the sign – Times New Roman – 12 mm high small letters.

### 9.12 Maintenance

69. The *safety measures* outlined above shall be maintained and tested in accordance with Regulation 48A of the Building Regulation 2012 (with amendments) and the following:

- a. AS 1851-2012, or the latest edition, if the fire safety system is within the scope of AS 1851.
- b. AS 2293.2-2019, or the latest edition, for emergency lighting and exit signage.
- c. The manufactures’ instructions and recommendations for each product.



## 10. Quantitative Engineering Tools and Parameters

### 10.1 Required Safe Egress Time versus Available Safe Egress Time Concept

The performance-based travel distances are addressed based on the determination and comparison of the time for occupants to evacuate and the time available for the evacuation to be completed safely. This form of analysis is known as a timeline analysis; or the Required Safe Egress Time (RSET) versus Available Safe Egress Time (ASET) analysis.

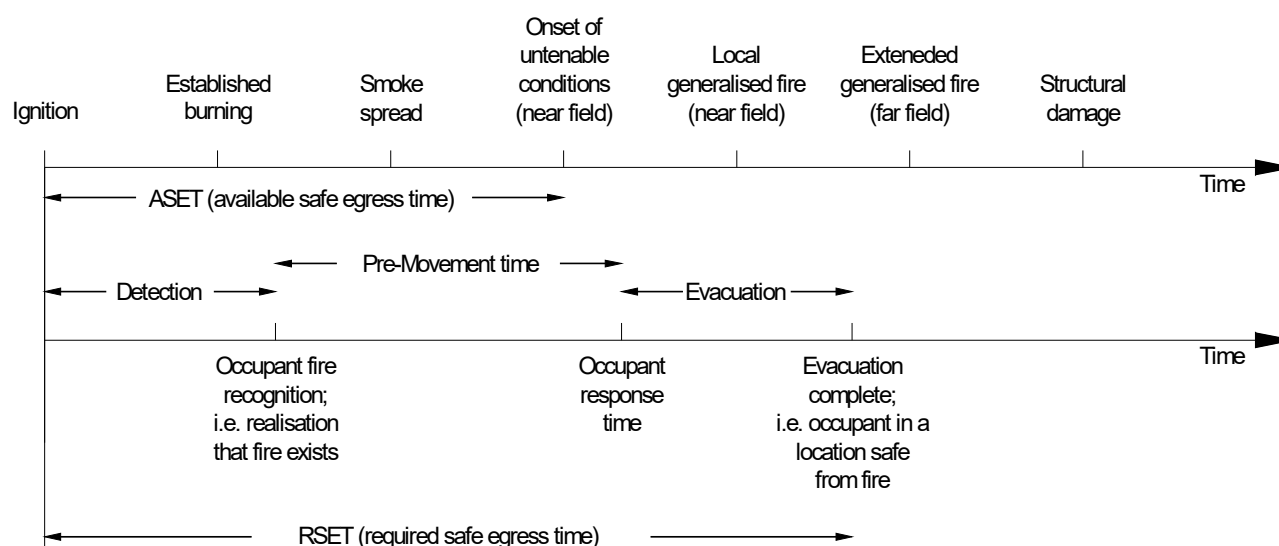


Figure 38: ASET versus RSET timeline diagram

Parameters required to undertake this assessment are defined in the following sections of this report.

### 10.2 Required Safe Egress Time (RSET) Modelling

The RSET is the sum of times incurred during the following three stages of the evacuation process:

- **Cue time** – time taken from effective ignition to the receipt of a cue by the occupants regarding the presence of a fire. In open plan areas occupants can also receive a cue upon development of a visible smoke layer under the ceiling.
- **Response (pre-movement) time** – time which extends from the cue to the time when occupants decide to evacuate. The degree of training and familiarity with the surroundings, as well as the general nature of the population, has an impact on the response time, together with the type of cue received. This period covers the time for occupants to assimilate the cue, resolve any ambiguity, undertake pre-evacuation actions and commence evacuation.
- **Egress time** – occupant evacuation time, which can be calculated on the basis of movement time to an exit and potential queuing time at the exit before reaching a place of relative safety.

$$T_R = t_d + t_{pm} + t_e$$

where :

$T_R$  is the total time of evacuation to a place of safety.

$t_d$  is the time of occurrence for an automatic or intrinsic fire cue.

$t_{pm}$  is the pre - movement time.

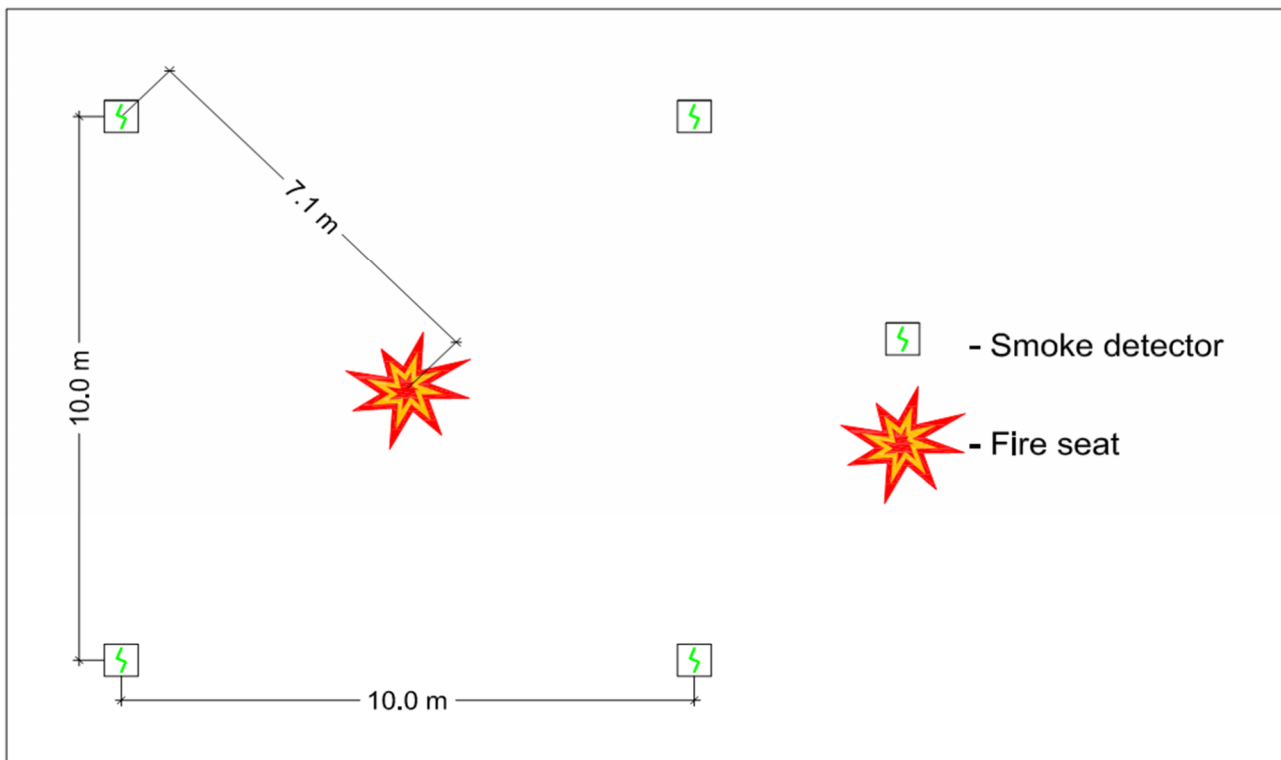
$t_e$  is the time necessary for occupants to move to a safe place.

*Equation 1: Total time for evacuation to a place of safety*

### 10.2.1 Cue Times ( $t_d$ )

The cue time in the performance-based design is based on the time it takes smoke of sufficient optical density to cover the distance between the axis of the fire plume and to activate the nearest smoke detector. The cue time in a BCA DtS compliant design is based on the time it takes occupants to become aware of the fire due to exposure to combustion products (see flames, smell smoke, hear fire related noises, such as cracking, popping, things falling downs, etc.) or due to an alarm being raised by others.

When smoke detectors are provided in accordance with Clause S20C4 of BCA Specification 20 and AS 1670.1-2018 on a nominal 10 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 7.1 m (refer to Figure 39 below).



*Figure 39: Distance from the axis of a fire plume to the nearest smoke detector installed on a 10 m x 10 m grid to Clause S20C4 of BCA Spec. 20 and AS 1670.1-2018*

Where smoke detectors are provided in accordance with Clause S20C6 of BCA Specification 21 and AS 1670.1-2018 a on a nominal 20 m grid, the maximum radial distance from the axis of the fire plume to the nearest detector should not exceed 14.1 m (refer to Figure 40 below).

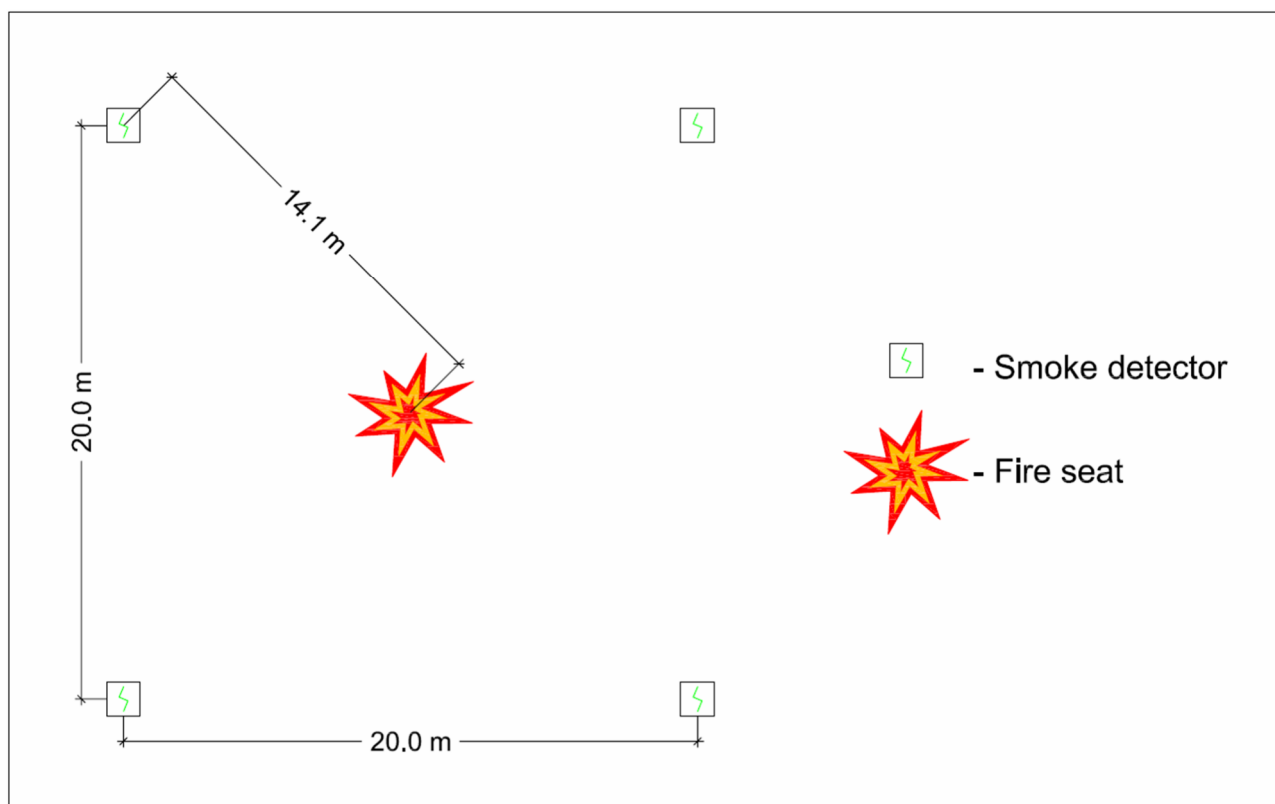


Figure 40: Distance from the axis of a fire plume to the nearest smoke detector installed on a 20 m x 20 m nominal grid

On site, detectors may be located closer than in the nominal grids; however, to provide a conservative estimate, the calculations were carried out using the nominal detector spacing.

One relatively crude method of predicting smoke detector activation times at different spacings and heights is identified in the *International Fire Engineering Guidelines* (IFEG) [ABCB, 2005a]. This method was developed by Heskestad [1981] and it suggests that once the temperature at the detector has reached approximately 13°C above ambient the detector is likely to have activated. More recent research however indicates that 13°C is an overly conservative value for most applications, with 4°C to 5°C temperature rise closely replicating experimentally observed smoke detector activation times [Bukowski, 1998].

This report adopts this method in comparative assessments and uses computer model CFAST [Peacock, 2023] to calculate detector activation times.

The smoke detection algorithm from the computer model FDS was used in the absolute assessment of the GSC, as an assessment carried out with the use of computer model CFAST may not provide an adequate estimation of smoke detector activation times under sloping ceilings/roofs.

The FDS algorithm is based on work by William Grosshandler and Tom Cleary from NIST, who developed an enhancement to the smoke detector activation algorithm, originally conceived by Heskestad and Steve Olenick of Combustion Science and Engineering (CSE), and implemented

this model in FDS [McGrattan, 2023]. In FDS the activation of smoke detectors is modelled using simple correlations of transport lag.

The alarm verification time for smoke detectors can be up to 20 seconds (Clause 2.11 of AS4428.1-1998, Amendment No.1 - 2004). This time is added to all calculated activation times of smoke detectors.

Where sprinklers are provided in accordance with AS 2118.1-2017 on a nominal 3 m x 4 m grid, the maximum radial distance from the axis of the fire plume to the nearest sprinkler should not exceed 2.5 m (refer to Figure 41).

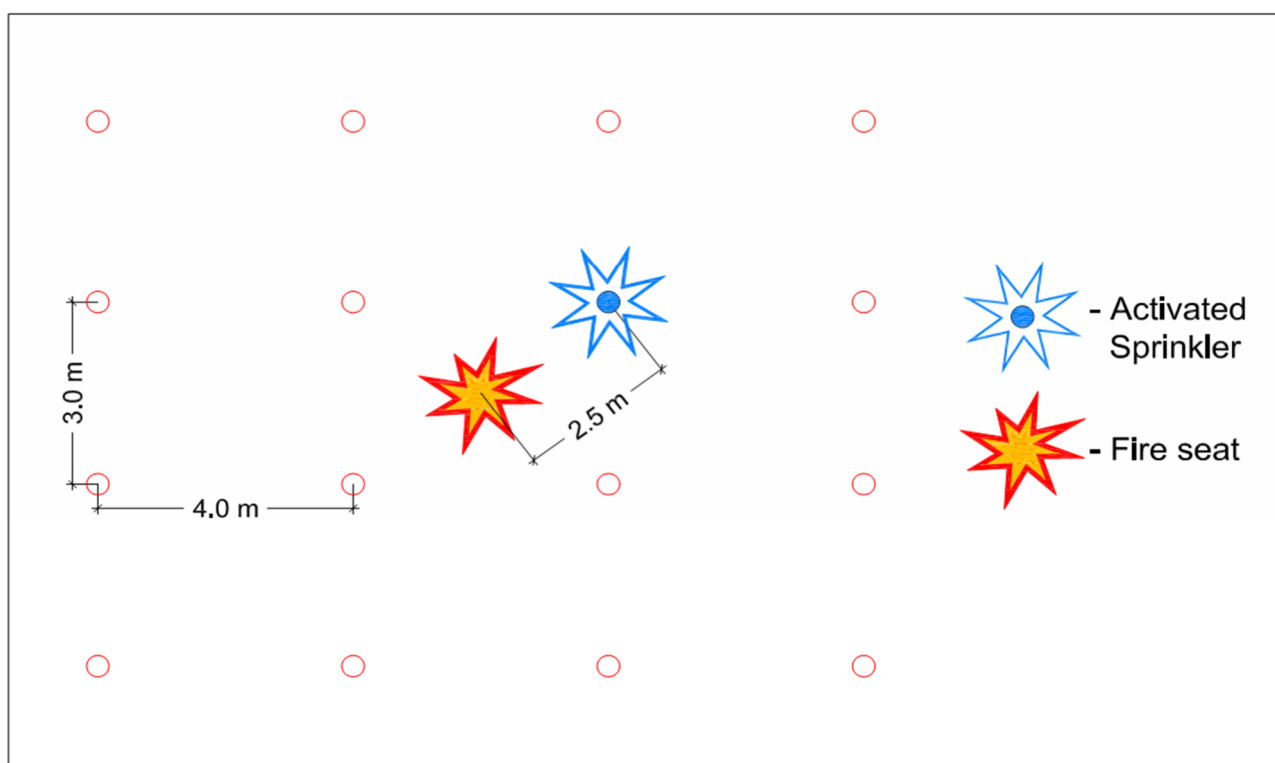


Figure 41: Distance from the axis of a fire plume to the nearest sprinkler installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017

The assessment uses module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013] to calculate sprinkler activation times in the comparative assessment where sprinklers are the primary detection system.

An additional delay in detection time is created by the depressurisation time of the sprinkler system.

On a small sprinkler system the depressurisation time is considered to be at least 30 seconds; however, on larger systems, the depressurisation time can be as high as 3 minutes [Table 2.4.1.2, Item No. 2.2(b) of AS 1851-2005]. Conservatively, for the purpose of the comparative assessment a 30 second depressurisation time is assumed.

### 10.2.2 Response Time ( $t_{pm}$ )

Response time (or pre-movement time) is the time taken between the moment when the cue is first received and the moment when movement to a place of safety begins.

Occupant response time involves the process of interpreting automatic and/or intrinsic cues and identifying them as a cause for evacuation. The response time is dependent upon the type of a cue. For the primary fire/smoke zone the cues may be in the form of:

- Alarm caused by smoke detection system activation.
- Sight or smell of smoke (based on a smoke depth which is 10% of the floor-to-ceiling height).
- Activation of the Building Occupant Warning System (BOWS).
- Notification and evacuation assistance by building management staff.
- Movement of a substantial number of occupants from the primary fire affected zone to an adjacent zone during evacuation.

Occupants close to the fire seat are expected to respond quicker than occupants remote from the fire seat due to the sight of fire and the strong smell of smoke.

Previous investigations in the occupant behaviour reveal that all occupants do not respond to a fire emergency at the same time. It has been observed in emergency evacuations in shopping centres that the staff assistance plays a critical role in the evacuation of occupants, which results in a reduction of the response time and a more efficient evacuation.

Table 3-13.1 of the SFPE Handbook [Proulx, 2002] provides suggested response times for various occupancies based on the type of warning system within the occupancies. These suggested times for retail occupancies range between less than 2 minutes (with live directives from staff) to more than 6 minutes (with fire alarm signal with no staff training). The basis of these estimates is not made clear, i.e. a link to recent experimental data or other justification is not clearly provided.

The above notwithstanding, research carried out in Sweden and the UK [Sandberg, 1997] indicates that pre-movement times less than 60 seconds may be appropriate based on real, unannounced, evacuation drills.

FCRC Project 6 [FCRRP, 1998c] suggests a pre-movement time of 60 seconds from the first sight of dense smoke may be appropriate in shopping centres in a serious fire scenario, and in less serious fire scenarios the pre-movement time may be extended, however there will be more time to evacuate.

Many occupants, especially those in the vicinity or direct line of sight from the fire are expected to respond to a fire cue much quicker and are likely to start movement soon after the cue is received. However, to provide an additional level of conservatism during evacuation scenarios it is assumed that all occupants would start moving at the same time.

A pre-movement time of 120 seconds is therefore considered suitably conservative and is adopted in the analysis.

### **10.2.3 Occupant Egress Time ( $t_e$ )**

Occupant egress time is the time taken for the occupants to walk to the exits, queue at the exits and eventually travel to a place of ultimate safety such as an open road.



Egress calculations in the comparative analysis that has a relatively simple architectural layout are based on the hand calculation methods presented in the SFPE Handbook (refer to Equation 2) [Gwynne, 2016a].

$$t = \frac{P}{F_s W_e}$$

Where:

$t$  the queuing time, sec.

$P$  the population in persons.

$F_s$  specific flow, persons/s/m.

$W_e$  effective width, m.

#### *Equation 2: Queuing time at exit*

The assumed travel speed is 0.8 m/s and a specific flow rate of 1.0 persons/s/m of effective width [DFES, 2021].

The effective width of an exits is determined by subtracting the boundary layer width of 304 mm from the width of the exit [Gwynne, 2016b]. For example, the effective width of a single 1.0 m door is 0.696 m.

Evacuation modelling of large occupant numbers from the GSC is carried out using computer model Pathfinder [TE, 2024]. The results are conservative because the modelling process assumes that the first person starts to move towards an exit after the cue and response times have elapsed, whereas in fact some people may commence moving towards the nearest available exit earlier due to direct visual contact with the fire and smoke.

It is hard to predict the exact occupant mix for a shopping centre; however, if it is based on a general population mix, it is considered to be an appropriate assumption. Based on the 2011 Australian Census 67.6% of Australian population are aged between 15 and 64 years old. Children under 15 comprise 18.9% and people over 65 years old – 13.5%. The outcomes of the Census indicate that 18.5% of the population have a disability.

To determine the movement speed of the building population it was assumed that people with a disability or otherwise physically impaired, people over 65 years old and children under 15 years old would be moving at 0.8 m/s. The rest of the population would be moving at 0.93 m/s [DFES, 2021a]. Assuming that 18.5% of the 15 to 64 years old age group is disabled (12.5% of the total population), the percentage of the total occupants moving at 0.93 m/s is approximately 55%.

The Pathfinder input parameters were adjusted accordingly to reflect that 55% of the population have a movement speed of 0.93 m/s and 45% of the population have a movement speed of 0.8 m/s.

It is assumed that contractors who may be present in the plantrooms are all able-bodied people and would have a movement speed of 0.93 m/s.

#### 10.2.4 Safety Factors

The International Fire Engineering Guidelines state that ASET should be greater than  $RSET \times \lambda_{esc}$ , where  $\lambda_{esc}$  is a factor of safety incorporated to ensure conservatism in the analysis of the reasonable worst credible fire scenario. There should be a margin incorporated in this to account for uncertainty and the potential consequence of any deficiencies in the analysis. The safety factor  $\lambda_{esc}$  is usually taken to be between 1 and 2.

The main uncertainties with the RSET are associated with the cue, pre-movement and egress times. Given that considerable conservatism is built into the quantification of these variables as detailed above, it is not considered appropriate to add significantly to this conservatism by requiring a high safety margin.

A margin of 50% (i.e., 1.5) greater than that calculated for cue, pre-movement and egress times is considered appropriate for the base case design fire scenarios.

Hence the criterion for acceptability of an outcome from a time-line analysis for the credible worst case design fire scenarios is:

$$ASET \geq 1.5 \times RSET$$

Redundancy and sensitivity fire scenarios normally attract a safety factor of 1, as these scenarios are less likely to happen and generally are assessed only to establish the robustness of the fire safety strategy.

$$ASET \geq 1.0 \times RSET$$

The IFEG also state that “*in a comparative evaluation, it should not be necessary to include explicit factors of safety because the same methods and assumptions for the analysis would be used for both the deemed-to-satisfy or prescriptive design and the proposed design*”. The comparative analysis therefore does not include a safety factor.

### 10.3 Available Safe Egress Time (ASET) Modelling & FDS Input Parameters

The ASET is determined through smoke development and movement modelling of the design and redundancy fire scenarios using computational fluid dynamics computer model FDS-6.8.0.

#### 10.3.1 Mesh Size

In FDS the approximate form of the conservation equation for mass, momentum, and energy is solved on a numerical grid. The size of the grid cells will determine how accurate the output results are. A coarse grid can provide reasonable predictions of certain quantities, especially those that can be traced directly to conservation equations of mass and energy, like temperature and visibility. However, with coarser grids the results are generally less reliable than those obtained with finer grids, and certain results cannot be obtained at all.

With any grid resolution study, a point of diminishing returns is reached when the improvement in the quality of the results is outweighed by the “cost” of the computation. When this point is reached depends on the application. It also depends on the quantities that are of interest. Some quantities, like hot smoke layer temperature or height, do not typically require as fine a numerical grid as quantities such as the heat flux to targets near the fire [McGrattan, 2023].

The “FDS User Guide” indicates that there is an alternative method of determining the appropriate grid cell size. It suggests that for simulations involving buoyant plumes, the cell size ( $\delta x$ ) can be correlated to the characteristic fire diameter ( $D^*$ ) [McGrattan, 2007]. A validation study sponsored by the US Nuclear Regulatory Committee [Stroup, 2013] indicates that the  $D^*/\delta x$  values in the range between 4 and 16 achieve good agreement with the experimental data for various fire scenarios.

The characteristic fire diameter can be determined using the following equation [McGrattan, 2007]:

$$D^* = \left( \frac{Q}{\rho_{\infty} c_p T_{\infty} \sqrt{g}} \right)^{\frac{2}{5}}$$

*Equation 3: Characteristic fire diameter*

Where:

- $D^*$  - characteristic fire diameter;
- $Q$  - total heat release rate of the fire (kW);
- $\rho_{\infty}$  - air density at ambient temperature  $\rho_{\infty} = 1.204 \text{ kg/m}^3$ ;
- $c_p$  - specific heat at ambient temperature  $c_p = 1.005 \text{ kJ/kg.K}$ ;
- $T_{\infty}$  - ambient temperature  $T_{\infty} = 23^{\circ}\text{C}$  (296K);
- $g$  - the acceleration due to gravity  $g = 9.81 \text{ m/s}^2$

### 10.3.2 Fire Reaction Parameters

In computational fluid dynamics (CFD) modelling where the smoke layer is generally not stratified, as opposed to zone modelling, it is also paramount to establish parameters (input data) that would correctly reflect the amount of toxic volatiles of smoke produced during the combustion process, as these will determine the tenability of the environment through which occupants may have to evacuate.

The contents of the retail mall present a mix of plastics, cellulosic materials and hydrocarbons. The fuel composition is therefore based on the following parameters:  $\text{CO}_2$  – 1.9 g/g; CO yield – 0.04 g/g; soot yield – 0.07 g/g; heat of combustion – 20 MJ/kg; and radiative fraction – 0.35 [MBIE, 2020].

It should be noted that the above values are more conservative than the values suggested in the Society of Fire Safety “Practice Note for Design Fires” [SFS, 2012].

### 10.3.3 Heat Release Rate per Unit Area

The heat release rate per unit area (HRRPUA) in sprinklered shopping centres can vary between  $270 \text{ kW/m}^2$  and  $1,200 \text{ kW/m}^2$  [Hopkin, 2019]. “Verification Method: Framework for Fire Safety Design” [MBIE, 2020] suggests HRRPUA values that range between  $500 \text{ kW/m}^2$  and  $1,000 \text{ kW/m}^2$  for “all buildings including storage with a stack height of less than 3.0 m”.

It is conservatively assumed that the HRRPUA is  $750 \text{ kW/m}^2$ , as a lower HRRPUA is expected to result in a cooler fire and less buoyant smoke.

## **10.4 Occupant Evacuation Limiting Criteria**

To establish the point in time at which the ASET is reached the following limiting criteria have been adopted to evaluate the performance-based egress.

### **10.4.1 Visibility and Temperature Limits**

It is widely accepted that occupants can evacuate safely if the visibility through the smoke stays at above 10 m in large spaces, and above 5 m in smaller spaces, and the smoke temperature does not exceed 60°C. Familiarity with the environment plays an important role as well [Purser, 2002].

The above notwithstanding, in experiments conducted by Jin it was determined that people would still walk through non-irritant smoke if the visibility was reduced down to 2.3 m [Purser, 2002]. However, in other experiments [Proulx, 2002] it was established that people would generally turn back if the visibility was around 3 m.

Therefore, the adoption of a visibility limit of 10 m and a temperature limit of 60°C is considered appropriate.

### **10.4.2 Availability of Exits**

The hot smoke layer height and its temperature are typically used as limiting criteria to determine the ASET for occupant evacuation in simulations using zone fire models. Typically, when the hot smoke layer descends below a defined height (e.g. 2.1 m), tenability is deemed to be lost across the entire compartment.

This concept however is too simplistic an approach when using field (CFD) fire models. CFD models can consist of hundreds of thousands of cells to simulate geometrical and spatial characteristics of a fire environment that could not be simulated in a zone fire model and the output data is correspondingly complex and detailed, and as such, more refined limiting criteria are considered appropriate.

For the purposes of this assessment the visibility and temperature limits are applied at a height of 2.1 m, however, some loss of tenability at this height may not be considered to result in ASET being reached.

For example, when using CFD models smoke may descend below the 2.1 m benchmark in different parts of the model environment without impeding safe evacuation of the occupants, i.e. one of the alternative exits can become obscured or even blocked by smoke; however, other exits are not compromised and are available (this concept is in line with the BCA DtS provisions – if one exit is blocked, an alternative exit must be available). Therefore, strictly using the 2.1 m benchmark across the entire domain may be inappropriate and the analysis may consider the specific building configuration where multiple exits are available and transient areas of low visibility that may not pose a significant risk to occupants.

### **10.4.3 Summary**

For the purpose of this assessment, it is assumed that it is acceptable for smoke during a fire simulation to descend below the 2.1 m benchmark above the finished floor level. However, smoke below this benchmark must satisfy the following limiting criteria:

- Visibility along required exit travel paths does not reduce to less than 10 m and the temperature does not exceed the 60°C benchmark at 2.1 m above the finished floor level [Purser, 2002]; or
- If travel paths to alternative exits are available from a point of choice, some localised loss of tenable conditions may be acceptable, only if alternative travel paths to an exit are available.

#### 10.4.4 Fire Brigade Intervention Limiting Criteria

The limiting criteria for DFES internal intervention are outlined in Table 19 below. The values indicated in Table 19 are described in the Australasian Fire Authorities Councils Fire Brigade Intervention Model (FBIM) as the limiting conditions for fire-fighters in full turnout gear.

| Tenability Criteria                                   | Limiting Value for Fire-fighters<br>(relative to 1.5 m above floor level) |                                |
|-------------------------------------------------------|---------------------------------------------------------------------------|--------------------------------|
|                                                       | Air Temperature (°C)                                                      | Radiation (kW/m <sup>2</sup> ) |
| Routine Conditions<br>(25 minutes maximum exposure)   | 100                                                                       | 1                              |
| Hazardous Conditions<br>(10 minutes maximum exposure) | 120                                                                       | 3                              |
| Extreme Conditions<br>(1 minutes maximum exposure)    | 160                                                                       | 4.0 – 4.5                      |

*Table 19: Maximum critical radiant heat flux allowed for fire brigades personnel in their protective clothing*

DFES recommends a maximum radiant heat flux for all calculations to be no greater than 2.5 kW/m<sup>2</sup> [DFES, 2021b], as snatch rescue situations cannot be predicted and should not be modelled. For conservatism, routine conditions, based on a maximum temperature of 100°C at a height of 1.5 m above floor level, are considered the limiting criteria for fire fighters.

#### 10.5 Design Fires

There is a large amount of data concerning the burning rates of items and materials; however, rarely is this information sufficiently generic to be universally adopted and applied to specific buildings. Also, what can be representative of current fuel loading for an enclosure may not be the case in the future. Therefore, it would be a rare assessment in which the specific items forming the fuel load had been tested to provide the fire heat release data.

Much experimental work has been carried out on the burning rates. These have been closely examined and translated into a simplified mathematical expression relating heat release to time after commencement of the flaming stage of the fire growth [Buchanan, 2001]. The unpredictable incubation phase (incipient stage) of fire development is not included. The basis of the mathematical simplification arises from the fact that the fire growth during the flaming stage can be approximated by a smooth curve that can be expressed mathematically.

Studies of actual fires have led to the adoption of five (5) standard fire growth rates covering a wide range of potential fire scenarios and fuel loads. As noted, the times of fire incubation are not included in the t-squared growth fire models.



Figure 42 illustrates the five typical fire growth rates. The design fire curve represents the initial stage of the fire. There is no or very little reliable data for fires where the rate of heat released exceeds 10 MW. This fire size represents the approximate limit for current test facilities.

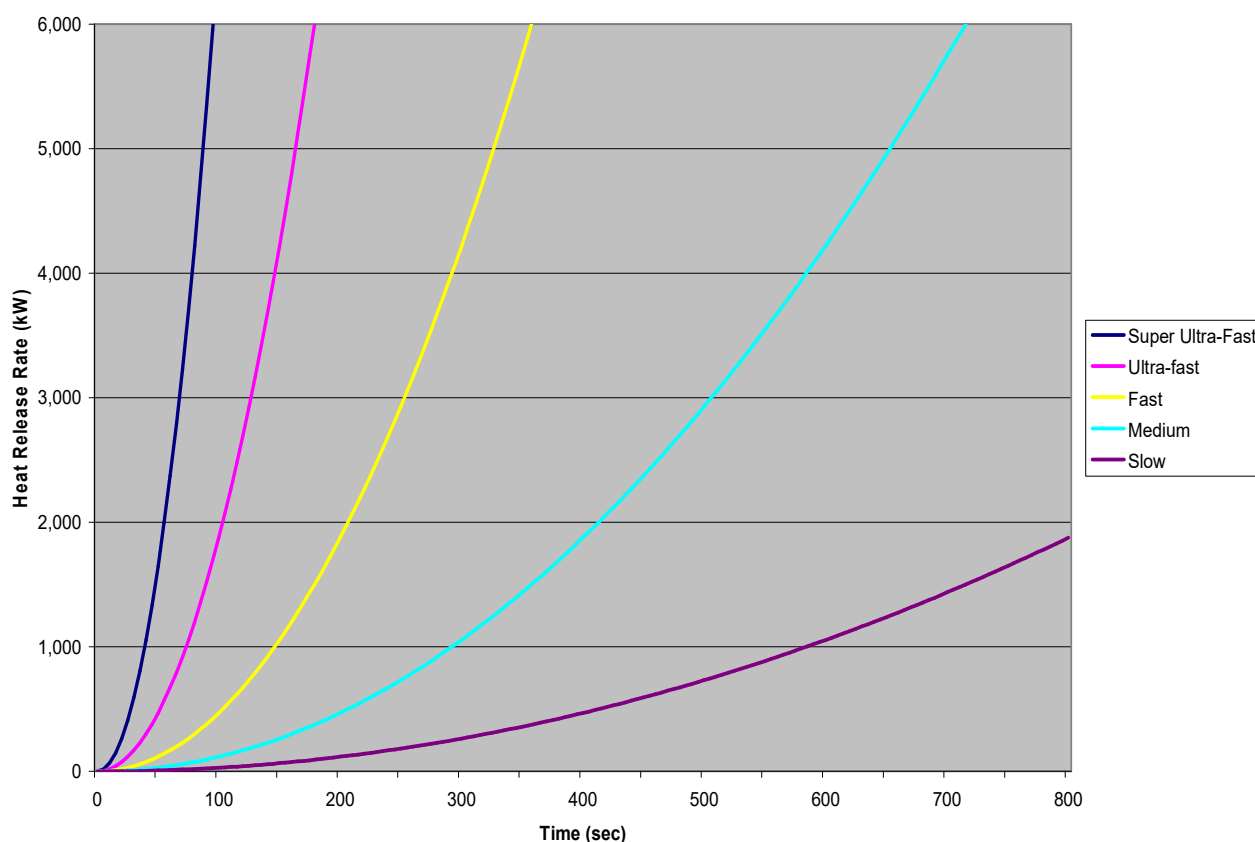


Figure 42: *t*-squared growth rate fires based on test data

Considering that it is impossible to predict with complete accuracy what fire will occur, it is reasonable to use a *t*-squared growth rate.

### 10.5.1 Fire Growth Rates

The heat release rate (HRR) of a *t*-squared (*t*<sup>2</sup>) growth rate fire at any given time can be determined using the following equation [Buchanan, 2001]:

$$Q = \alpha \times t^2$$

Equation 4: Heat release rate of a *t*-squared fire

where:

*Q* - the heat release rate of the fire, kW.

*α* - fire intensity coefficient, kW/s<sup>2</sup>.

*t* - time, s.

The heat release rate vs. time relationship for a range of *t*<sup>2</sup> growth rate fires is illustrated in Table 20 below [Buchanan, 2001]:

| Time<br>(s) | Heat Release Rate (kW) |                   |                 |                      |                            |
|-------------|------------------------|-------------------|-----------------|----------------------|----------------------------|
|             | Slow<br>(K-600)        | Medium<br>(K-300) | Fast<br>(K-150) | Ultra-fast<br>(K-75) | Super Ultra-fast<br>(K-40) |
| $\alpha$    | 0.0029                 | 0.0117            | 0.0469          | 0.1876               | 0.6594                     |
| 0           | 0                      | 0                 | 0               | 0                    | 0                          |
| 25          | 2                      | 7                 | 29              | 117                  | 412                        |
| 50          | 7                      | 29                | 117             | 469                  | 1,649                      |
| 100         | 29                     | 117               | 469             | 1,876                | 6,594                      |
| 150         | 66                     | 264               | 1,055           | 4,221                | 14,837                     |
| 200         | 117                    | 469               | 1,876           | 7,504                | 26,376                     |
| 250         | 183                    | 733               | 2,931           | 11,725               | 41,213                     |
| 300         | 264                    | 1,055             | 4,221           | 16,884               | 59,346                     |
| 350         | 359                    | 1,436             | 5,745           | 22,981               | 80,777                     |
| 400         | 469                    | 1,875             | 7,504           | 30,016               | 105,504                    |
| 450         | 593                    | 2,373             | 9,497           | 37,989               | 133,529                    |
| 500         | 733                    | 2,931             | 11,725          | 46,900               | 164,850                    |
| 550         | 886                    | 3,545             | 14,187          | 56,749               | 199,469                    |
| 600         | 1,055                  | 4,221             | 16,884          | 67,536               | 237,384                    |

Table 20: Time vs. Heat Release Rate for a range of  $t^2$  growth rate fires

Retail occupancies in general are comprised of a variety of stores that contain mixed types of commodities and have different types of storage configurations. Some areas could have a specific line of products, but most have a mix of cellulosic, plastic, and non-combustible materials. Combustibles displayed and/or stored in vertical configurations are expected to create the worst fire growth rates.

A lot of research has gone into determining the appropriate fire growth rates for different occupancies. While some researchers indicate that for retail occupancies 'ultra-fast' t-squared growth rate fires would be appropriate for design fire scenarios [Karlsson, 1999], the majority of publications [SFS, 2012; MBIE, 2020] indicate that the most appropriate t-squared growth rate fire for retail areas is 'fast'. The sensitivity fires however are assessed using an 'ultra-fast' t-squared growth rate.

### 10.5.2 Fire Size

The design fire curve represents the initial stage of the fire. For a nominated fire scenario, the design fire is modified to take into account either the action of the fire suppression measures, or the reduction of the available fuel load, or lack of ventilation. These design fires are used in computer models to determine the smoke spread throughout or between the enclosures.

Occupant intervention and its impact on the fire size is usually ignored, as it cannot be relied upon (except for industrial fire brigades) and generally cannot be quantified.

The maximum fire size in a building that is not fitted with an automatic fire sprinkler system is either ventilation or fuel controlled and can be determined using appropriate equations.

It is also possible to establish the maximum fire size in a building that is provided with an automatic fire sprinkler system. Sprinkler activation could result in three possible outcomes (refer to Figure 43 below) [ABCB, 2005b; Staffansson, 2010]:

- (A) Sprinkler activation does not have any effect on the fire growth rate – red line in Figure 43. This outcome is highly unlikely; however, under certain conditions (the sprinkler system is not designed for the fire load present; inadequate water supply; abnormal fire growth rate; etc.) it is possible; or
- (B) Sprinkler activation controls the fire growth rate – blue line in Figure 43. Generally, this is a conservative assumption; or
- (C) Sprinkler activation results in the fire being extinguished – green line in Figure 43. Upon activation, appropriately designed; installed and maintained fire sprinkler systems are highly likely to reduce the heat release rate of a fire and potentially extinguish it; however, this approach is not considered sufficiently conservative for most applications.

There are different ways of determining the HRR versus time curve during a sprinkler-controlled fire scenario.

Based on research carried out in Sweden, Nystedt [2011] suggests that for heat release rates below 5 MW at the time of sprinkler system activation ( $Q_{act}$ ), the HRR could remain constant for 60 seconds and then be reduced to 1/3 of the  $Q_{act}$ , after which time the HRR should remain constant for the duration of evaluation. For  $Q_{act}$  of greater than 5 MW, Nystedt suggests that upon sprinkler activation the HRR shall remain constant for the rest of the evaluation and be equal to  $Q_{act}$ .

This approach suggests that  $Q_{act}$  can be equal to  $Q_{ctrl}$ . However, fire tests replicating an office environment that were carried out in China [Chow, 2005], indicate that an increase of HRR after sprinkler system activation could be as high as 50% (refer to Figure 44 below), however, the fire size then quickly reduces compared to a similar fire with no sprinkler activation.

To make sure that a conservative assessment is provided, the following approach has been adopted to determine the HRR versus time curve for the design and sensitivity fire scenarios:

- i. Fire grows with a given t-squared growth rate (e.g. 'medium', 'fast', or 'ultra-fast') until activation of a sprinkler on the first row of sprinkler heads. The axis of the fire plume is assumed to be located in the middle of a rectangular array of four (4) sprinkler heads as illustrated in Figure 46.
- ii. Upon activation of the first sprinkler, the growth rate of the fire is reduced to the next lower growth rate, e.g. 'fast' is reduced to 'medium' growth rate.
- iii. Thereafter, the fire keeps growing at the reduced t-squared growth rate until at least five (5) sprinklers are activated, i.e. at least one (1) sprinkler has activated on the second row of sprinkler heads.

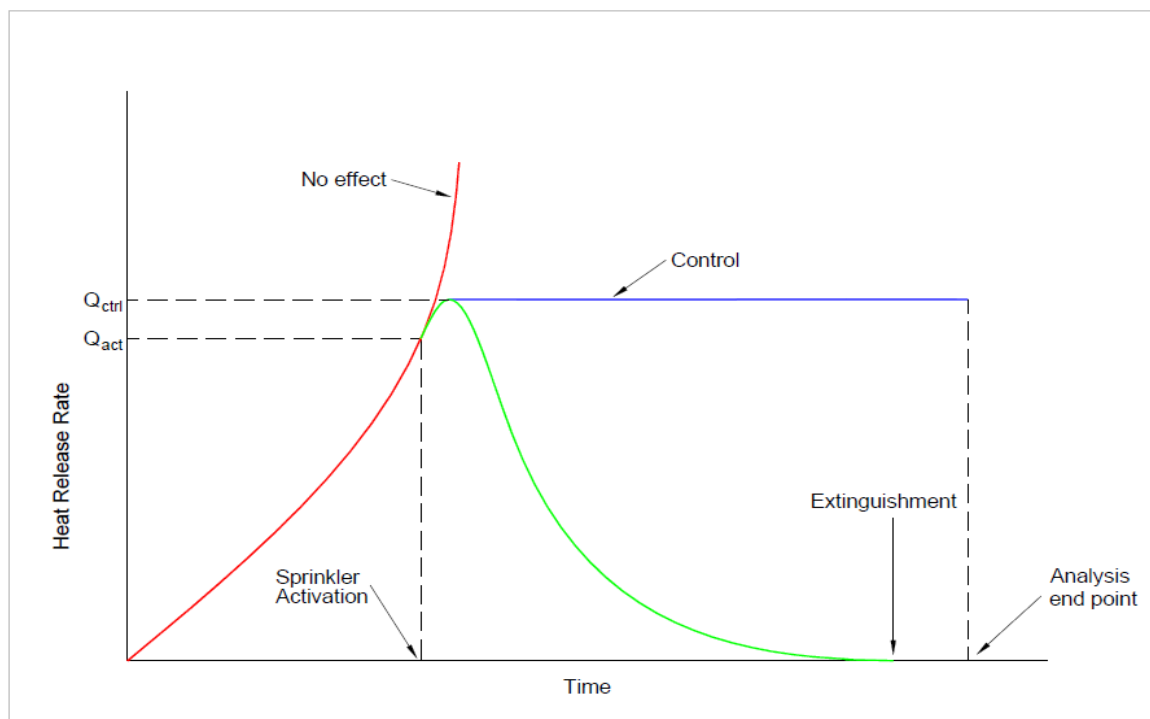


Figure 43: Possible effects of sprinkler system activation on the fire heat release rate

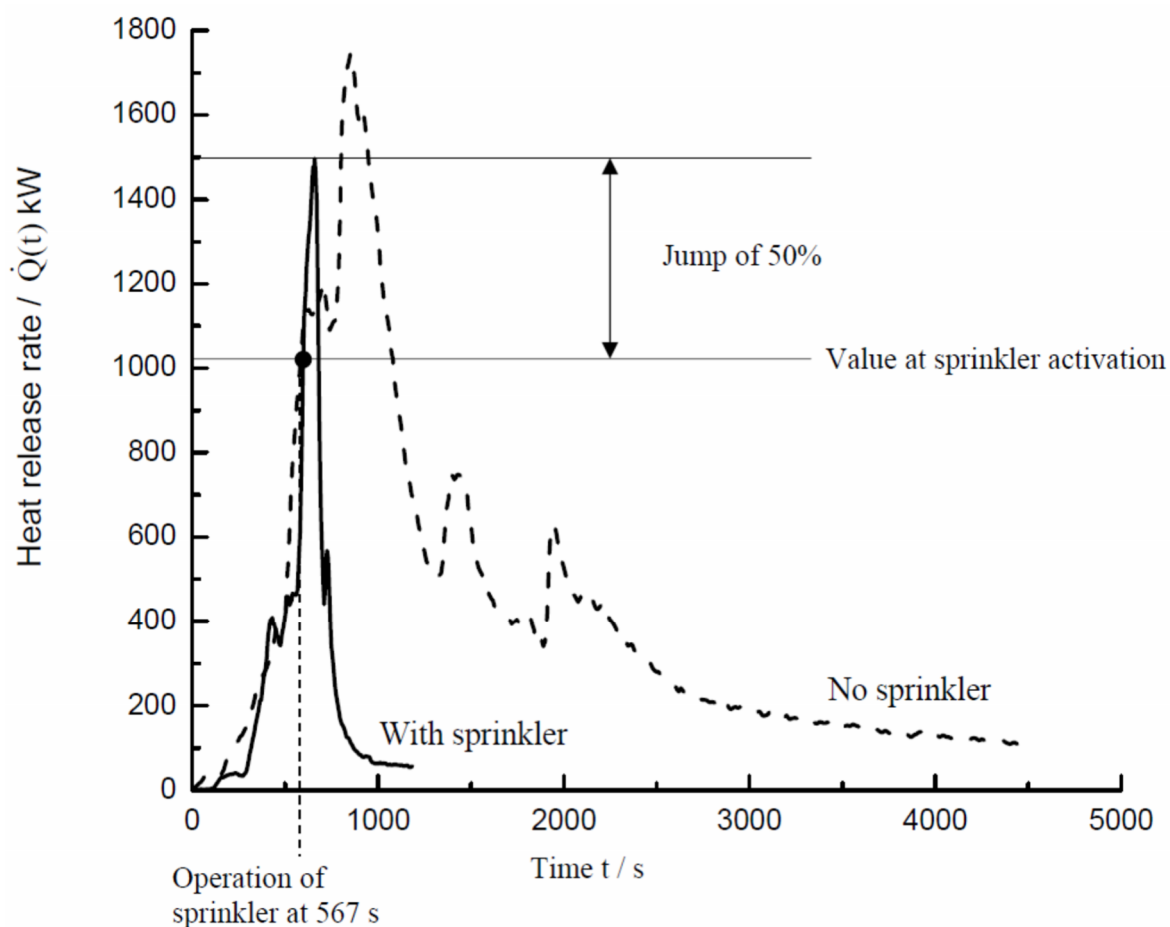


Figure 44: Heat release rate observed in experiment carried out at Chinese Assembly Calorimeter

The above approach results in a schematic fire design curve illustrated in Figure 45 below.

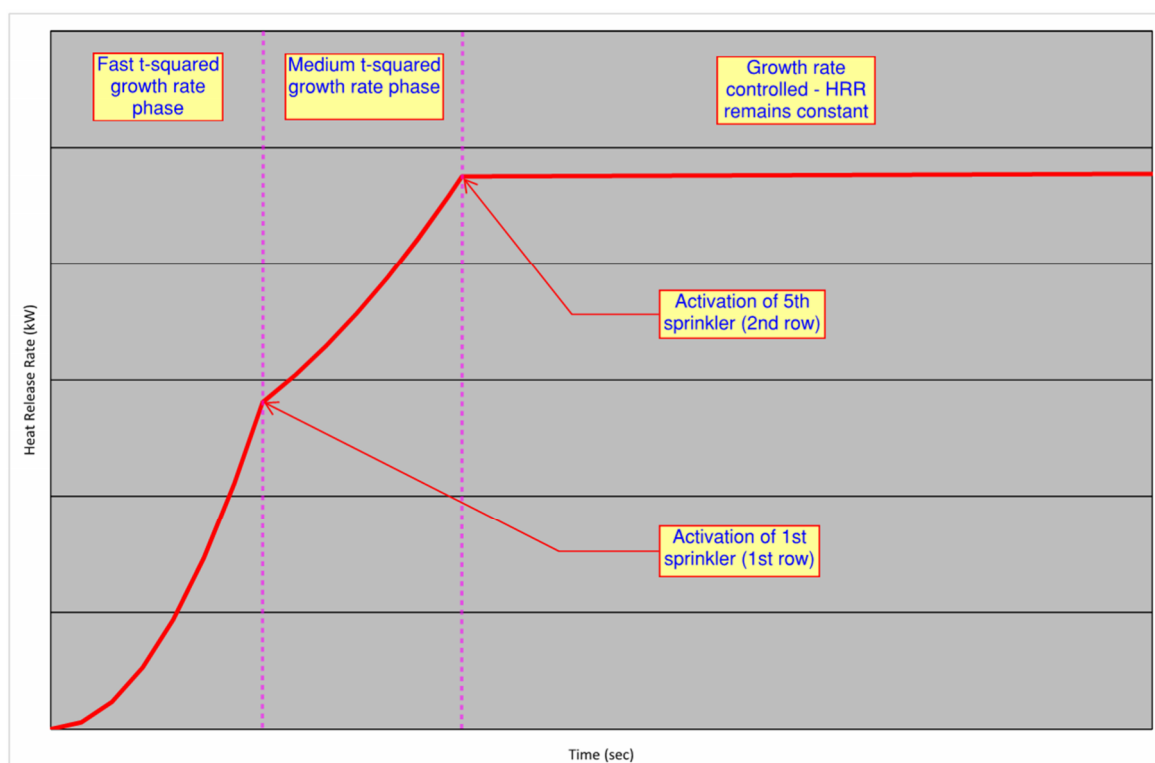


Figure 45: Schematic fire design curve for design fire scenarios

Module Sprinkler from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013a] is used to calculate sprinkler activation times.

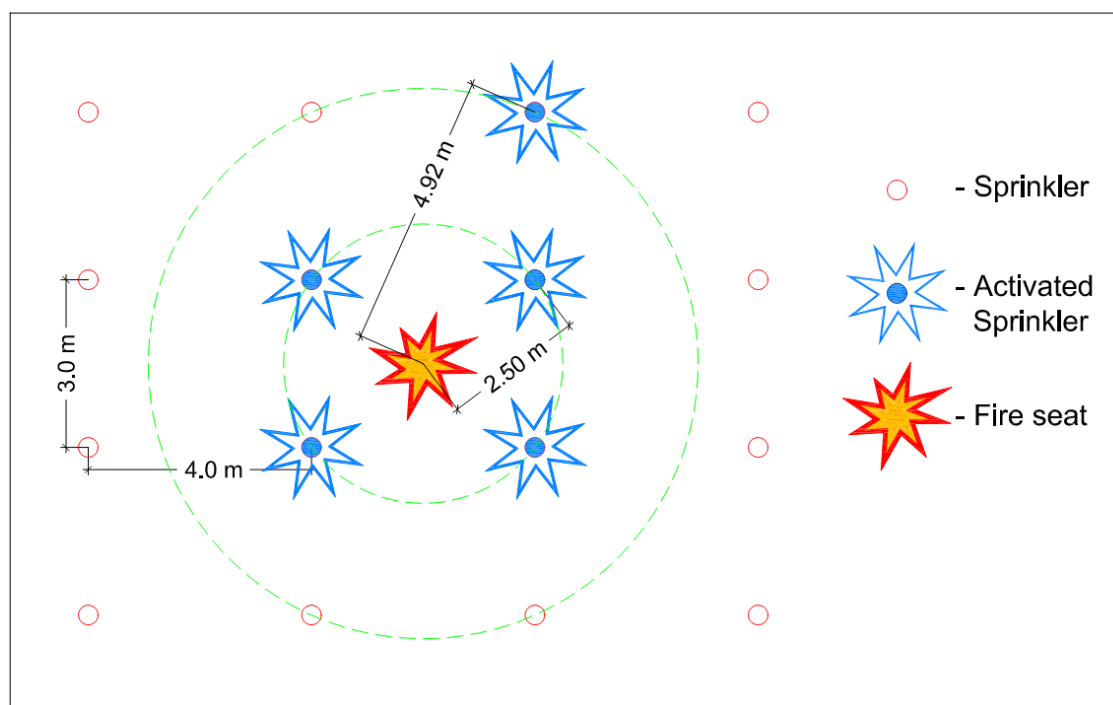


Figure 46: Distance from the axis of a fire plume to the first and fifth sprinklers installed on a nominal 3 m x 4 m grid in accordance with AS 2118.1-2017



## 11. Performance Solution No. 1 – Performance-based FRL of Loadbearing Structure

### 11.1 Relevant BCA DtS Provisions

BCA Clause C2D2(1) states that the fire-resisting construction of a building must be that specified in Table C2D2, i.e. a 3-storey building containing Class 6 and Class 9b parts, where Class 6 is the top floor, shall be of Type B construction.

BCA Clause C2D2(2) states that each building element must comply with Specification 5 as applicable.

Table S5C21e of BCA Specification 5 states that loadbearing fire-resisting lift and stair shafts in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/120/120.

Table S5C21g of BCA Specification 5 states that loadbearing internal walls and columns in a Class 6 and Class 9b building of Type B construction where different classifications are not fire separated shall achieve FRL180/--/--.

### 11.2 Performance Solution

The GSC is an existing 3-storey mixed use development that contains Class 6 (retail) and Class 9b (cinema) parts that are not fire-separated (Class 6 is the top floor); therefore, the prescribed construction type is Type B.

The loadbearing lift shaft in Tenancy 1-165 achieves FRL 120/120/120 in lieu of FRL 180/120/120, which does not comply with the DtS provisions of Table S5C21e of BCA Specification 5.

The loadbearing columns that support the First Floor slab in areas highlighted red in Figure 47 achieve FRL 120/--/-- in lieu of FRL 180/--/--, which does not comply with the DtS provisions of Table S5C21g of BCA Specification 5.



Figure 47: Ground Floor areas where load bearing structure has performance-based reduced FRL

### 11.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as C1P1.

### 11.4 Assessment Method

The assessment methods adopted are BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”* and BCA Assessment Method A2G2(2)(d), i.e. *“comparison with the Deemed-to-Satisfy Provisions”*.

### 11.5 Intent of the BCA

The intent of Performance Requirement C1P1 (formerly CP1), in accordance with the Guide to the BCA, which provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020-2], is to ensure that the building has a structure that, *“to the degree necessary”*, should withstand the impact of a fire and should not have localised or catastrophic collapse as a result of it.

The Guide to the BCA states that the use of words *“to the degree necessary”* means that the *“BCA recognises that different building elements require differing degrees of structural stability during a fire. The expression is intended to allow the appropriate authority to determine the degree of compliance necessary in each particular case”*.

The above notwithstanding, the Guide states that *“while assessment of a building proposal must have regard to the differing needs of each building element, the proposal must make sure that the elements have an appropriate structural stability during a fire so that:*

- *“the fire does not endanger the occupants by entering escape routes; and*
- *“the fire does not endanger fire fighters while they are undertaking search and rescue operations”*.

It is evident that the reduced FRL of the loadbearing structure may contribute to premature structural failure, which may compromise safe occupant evacuation and fire brigade intervention.

### 11.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based reduced FRL of the loadbearing structure (columns and the lift shaft) would not increase the risk of structural collapse.

If it can be demonstrated that an uncontrolled fire during a sprinkler failure scenario in areas provided with ample ventilation (tenancies, plant room AP.ENT, loading dock 04 and external area along the south-east façade – areas highlighted green in Figure 48 below) and without relying on fire brigade intervention burns out before the nominal FRL of the loadbearing structure is reached, it is considered that compliance with Performance Requirement C1P1 is achieved.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.



*Figure 48: Areas subject of performance-based FRL assessment*

If it can be demonstrated that the fire safety performance of the performance-based design in areas with restricted ventilation (store rooms – areas highlighted green in Figure 48) is better or at least equal to that afforded by a BCA DtS compliant design, it is considered that compliance with Performance Requirement C1P1 is achieved on a comparative basis.

The methodology adopted for the assessment of areas provided with ample ventilation is an absolute quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify fire scenarios that potentially could cause collapse of the loadbearing structure.
2. Identify fire loads and ventilation conditions for areas where a fire could cause collapse of the performance-based loadbearing structure.
3. Undertake burn-out calculations using the Eurocode formula [EC1, 2002] to establish the equivalent fire severity during a total burnout.
4. Determine whether burnout of the critical areas is expected to occur before the nominal FRL is reached, without relying on fire brigade intervention.

The methodology adopted for the assessment of areas with restricted ventilation is an absolute qualitative comparative analysis in accordance with the following:

1. Identify fire scenarios that potentially could cause collapse of the loadbearing structure.
2. In consultation with the building surveyor develop and document a hypothetical reference BCA DtS compliant base case design and document the performance-based design. These designs are detailed in Table 21 below.

3. Compare the fire safety performance of the performance-based design with that of the BCA DtS compliant design. The Australian Fire Engineering Guidelines indicate that to assist in analysing a fire safety system, it is convenient to consider the system as comprising six 'sub-systems': "Fire Initiation and Development and Control"; "Smoke Development and Spread and Control"; "Fire Spread and Impact and Control"; "Fire Detection, Warning and Suppression"; "Occupant Evacuation and Control"; and "Fire Services Intervention". The comparative performance analysis of the BCA DtS compliant design and the performance-based building design will be carried out for each of the 'sub-systems' recommended by the AFEG.
4. If it can be demonstrated that the fire safety performance of the performance-based design is better or equal to that afforded by a BCA DTS compliant design, then compliance with the relevant Performance Requirements of the BCA is achieved on a comparative basis.

### 11.7 Comparative Characteristics

The comparative characteristics of the BCA DtS compliant design and the performance-based design are summarised in the table below:

| Parameter                                    | BCA DtS compliant design                                                                                            | Performance-based design                                                                  |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Building classification                      | Class 6 (retail)                                                                                                    | Class 6 (retail) and Class 9b (cinemas)                                                   |
| Rise-in-storeys                              | 2                                                                                                                   |                                                                                           |
| Type of Construction                         | Type C                                                                                                              | Type B                                                                                    |
| Occupancy                                    | BoH storage                                                                                                         |                                                                                           |
| Building classification supported by columns | Class 6                                                                                                             |                                                                                           |
| Affected area                                | 300 m <sup>2</sup>                                                                                                  | Area 1 – 247 m <sup>2</sup><br>Area 2 – 100 m <sup>2</sup>                                |
| Floor-to-soffit height                       | 4.5 m                                                                                                               |                                                                                           |
| FRL of the loadbearing structure             | --/--/--                                                                                                            | 120/--/--                                                                                 |
| Fire hose coverage                           | Fire hose coverage to the fire affected areas is provided with 2 lengths of hose from external attack fire hydrants |                                                                                           |
| Fire suppression system                      | Automatic fire sprinkler system to AS 2118.1, provided with standard response sprinklers                            | Automatic fire sprinkler system to AS 2118.1, provided with fast response sprinkler heads |
| Fire detection and alarm system              | Nil                                                                                                                 | Fire detection and alarm system to Clause S20C4 of BCA Specification 20 and AS 1670.1     |
| Building Occupant Warning System             | BOWS in accordance with Clause S20C7 of BCA Specification 20 and AS 1670.1                                          | EWIS in accordance with Clause E4D9(d) of BCA and AS 1670.4                               |

Table 21: Comparative characteristics for the BCA DtS compliant design and performance-based design

### 11.8 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Design fire scenario (sprinkler system performs as designed): the loadbearing structure with performance-based reduced FRL shall not fail.*
2. *Redundancy fire scenario (sprinklers fail to operate as designed):*
  - a. *For areas provided with ample ventilation: a potential fire in the areas where loadbearing structure with performance-based reduced FRL is present shall burn out in not more than 120 minutes.*
  - b. *For areas with restricted ventilation: the fire safety performance of the performance-based design must be better or at least equal to that afforded by a BCA DtS compliant design.*

### 11.9 Fire Scenarios Selection

An important factor of a fire safety engineering assessment is identifying appropriate fire scenarios. These scenarios are identified by considering fire hazards present and their potential consequences. The process of fire scenario selection is based around identifying those fire scenarios which might be considered “worst-credible” that is having the following aspects:

1. The most likely; and
2. Having the worst impact or consequence; and/or
3. Highlighting the performance of the identified areas of non-compliance during a fire emergency.

The following fire scenarios were considered in the assessment:

1. Design fire scenario – occupants extinguish a potential fire in the incipient stages of its development.
2. Design fire scenario – sprinklers suppress, or control fire spread.
3. Redundancy fire scenario – sprinklers fail to operate as designed; staff are not available to extinguish the fire or cannot control the fire; the fire spreads uncontrolled and reaches flashover.

The above scenarios are discussed in the following sections.

#### 11.9.1 Fire Extinguished by Occupants

Staff are present in the GSC during trading hours and security are present 24/7. These occupants may have basic firefighting training. It is therefore reasonable to assume that a routine fire may be extinguished by staff and/or security before the sprinkler system activates.

A fire extinguished by occupants does not pose any threat to the loadbearing structure with performance-based reduced FRL, which satisfies the nominated acceptance criterion; hence further discussion of this fire scenario is not required.



### **11.9.2 Fire Extinguished or Controlled as a Result of Sprinkler Activation**

The GSC is protected with a sprinkler system that is expected to control or extinguish a potential fire that was not controlled by the occupants. The potential for successful sprinkler operation and the fire being either extinguished or controlled is considered to be high (refer to the sprinkler performance discussion in Section 11.9.4 below).

The impact on the loadbearing structure is expected to be negligible when the installed fire sprinkler system extinguishes the fire. During such scenario the fire would grow until sprinklers activate, and thereafter the fire would cease to grow in intensity, i.e. the fire would have a constant heat release rate until extinguished by the attending fire brigade, or all fuel load is consumed. The temperature of the ceiling jet prior to sprinkler operation could reach approximately 250°C. Upon sprinkler activation, even if the fire is not extinguished, the temperatures within the area of operation generally should be below 200°C, except in the immediate vicinity of the flames. Outside the area of operation, the temperature should be below 100°C [BCC, 2000a].

When sprinklers operate, the exposed structure is expected to be cooled by the water spray. Tests conducted as part of the Fire Code Reform Research Program indicated that even lightweight members were not significantly affected by exposure to a sprinkler-controlled fire [FCRRP, 1998b]. Therefore, the impact on the loadbearing structure during a sprinkler-controlled fire is expected to be negligible due to the comparatively low temperatures, which satisfies the nominated acceptance criterion, and further discussion of this fire scenario is not warranted.

### **11.9.3 Sprinkler Performance**

A scenario in which occupants fail to extinguish the fire and fire sprinklers fail to operate as designed is not likely, however possible. In this scenario the fire could grow to reach flashover, depending on the fire load in the affected area and the ventilation conditions.

Flashover is expected to occur when the hot layer temperature reaches between 500°C and 600°C [Thomas, 1981]. In the event of total sprinkler failure, this could occur before fire brigade arrival, especially in relatively small spaces.

It is useful to demonstrate that the probability of a total sprinkler failure is extremely low, before examining an uncontrolled fire scenario in detail.

### **11.9.4 Sprinkler Performance**

An assessment of sprinkler performance in Australia between 1886 and 1986 showed that sprinkler operation was unsatisfactory in 0.54% of the 9,022 fires reported [Marryatt, 1988].

A similar assessment of sprinkler performance in the USA between 1897 and 1969, carried out by Richardson, showed that sprinkler performance was unsatisfactory in 3.85% of the 81,425 fires reported [Richardson, 1983].

Richardson also lists the causes of unsatisfactory sprinkler performance; with the percentages prepared by Rohr [2003], where the 100% total reflects the 3.85% of unsatisfactory cases (refer to Table 22 below):

| Problem                                     | Percentage of Cases |
|---------------------------------------------|---------------------|
| Water shut off                              | 35.4*               |
| System not adequate for level of hazard     | 13.5                |
| Inadequate water supplies                   | 9.9                 |
| Inadequate maintenance                      | 8.4                 |
| Obstruction to water distribution           | 8.2                 |
| System designed for partial protection only | 8.1                 |
| Faulty building construction                | 6.0                 |
| Antiquated system                           | 2.1                 |
| Slow Operation                              | 1.8                 |
| Defective dry-pipe valve                    | 1.7                 |
| Exposure fire                               | 1.7                 |
| System frozen                               | 1.4                 |
| Other unknown                               | 1.9                 |
| <b>Total</b>                                | <b>100.0</b>        |

Table 22: Summary of sprinkler systems failure analysis

Note \*: Anecdotal evidence suggests that this value is very high and skewed due to the number of fires in empty/derelict buildings in which the sprinklers have been turned off.

In addition to the above statistics, a recent analysis of data for fires in premises in the UK in which sprinkler systems were fitted over the period of 2011 to 2016 [NFSN/NFCC, 2017] suggests that sprinklers worked as intended in 94% of cases and controlled or extinguished fire in 99% of cases when activated.

A reliable performance of a sprinkler system is dependent on adequate design, sound maintenance and good management of the system.

The GSC is protected throughout with an automatic fire sprinkler system that shall be installed in accordance with AS 2118.1 and shall be appropriate for the hazard protected. The system shall be soundly maintained in accordance with AS 1851-2012 and appropriately managed, which eliminates the majority of the causes for unsatisfactory sprinkler performance listed above.

In view of the above statistics sprinkler failure is not a likely event; however, full sprinkler failure fire scenarios were considered to adequately address the resilience of the performance-based design.

#### 11.10 Equivalent Fire Severity (Burnout) Assessment Basis

The fire resistance level of a building element, as detailed in AS 1530.4, is derived by exposing the element to a “standard fire curve” and determining when the element has failed based on a number of failure criteria. The standard fire curve however is at best an approximation of the conditions that may be expected during a real fire.

A number of methodologies have been developed to determine the fire severity in a post-flashover fire, i.e. empirical relationships (also known as time-equivalence formulae) that attempt to relate the performance of a building element exposed to a compartment fire to the performance when exposed to the standard fire curve.

The Law formula [BCC, 2000b] does not consider the impact of the room lining materials on the severity of the fire and the CIB W14 formula [Thomas, 1986] does not account for horizontal ventilation openings. Both these formulae are considered outdated and were not used in this assessment.

The method adopted for this analysis is the Eurocode formula that allows to carry out calculations for spaces with both vertical (doors and windows) and horizontal (ceiling or roof vents) openings [EC1, 2002]. Although the Eurocode formula is based on the thermal performance of insulated steel members, it is widely used for structural performance of concrete and many other materials. The formula contains a number of assumptions and approximations but is generally accepted as capable of providing a first-order estimate of the required performance.

The equivalent fire severity, determined using the Eurocode formula (refer to Equation 5), depends on the fuel load density in the room of fire origin and the ventilation conditions.

$$t_e = k_b * w_f * e$$

*Equation 5: Eurocode formula*

where:

$t_e$  – equivalent fire severity (min).

$k_b$  – conversion factor for wall thermal properties – 0.09 min\*m<sup>2</sup>/MJ (plasterboard walls and ceiling).

$w_f$  – dimensionless ventilation factor.

$e$  – fuel load density (MJ/m<sup>2</sup>).

The dimensionless ventilation factor is dependent on the number and dimensions of openings, as well as the floor area and the height of the room, and can be expressed using the following equation:

$$w = \left( \frac{6.0}{H_r} \right)^{0.3} * \left[ 0.62 + \frac{90 * (0.4 - \alpha_v)^4}{1 + b_v * \alpha_h} \right] > 0.5$$

*Equation 6: Dimensionless ventilation factor*

where:

$H_r$  – height of the room (m).

$\alpha_v$  –  $A_v/A_f$ ,  $0.025 \leq \alpha_v \leq 0.25$ .

$\alpha_h$  –  $A_h/A_f$ ,  $\alpha_h \leq 0.20$ .

$b_v$  –  $12.5 * (1 + 10\alpha_v - \alpha_v^2)$ .

$A_f$  – floor area of the fire room (m<sup>2</sup>).

$A_v$  – area of vertical vents (doors and windows) ( $m^2$ ).

$A_h$  – area of horizontal openings in the ceiling ( $m^2$ ).

It is considered for the purpose of this assessment that during redundancy fire scenarios (sprinklers fail to operate as designed) 75% of the glazing in the retail shopfronts fails. In the retail tenancies, a 95% fractile fire load is used ( $1,300 \text{ MJ/m}^2$  based on 'shops' mean value as per Table 3.4.1b of the IFEG [ABCB, 2005c]). The fractile fire loads in plant room AP.ENT and loading dock 04 are  $400 \text{ MJ/m}^2$  [MBIE, 2020].

The above assumptions result in multiple levels of concurrent redundancies: sprinklers fail to operate; the fire load is 95% fractile of the mean value for the retail tenancies; and fire brigade does not commence attack on the fire for 2 hours. It is unlikely that all these conditions would happen concurrently in a real fire emergency; therefore, it is acceptable to assume that during redundancy fire scenarios 75% of the glazing in the retail shopfronts fails.

A room that is not provided with windows and has the door closed is not expected to support combustion for an extended period of time, as oxygen supply to the fire will be limited.

## 12. Performance Solution No. 2 – Non-fire-rated Plant Rooms and Cabling to AHUs

### 12.1 Relevant BCA DtS Provisions

BCA Clause C3D13(1)(c) states that central smoke control plant must be separated from the remainder of the building with construction complying with (4).

BCA Clause C3D13(4)(a)(i) states that separating construction must have an FRL as required by Specification 5, but not less than 120/120/120.

Specification 5 does not prescribe an FRL for non-loadbearing internal walls bounding plant rooms in a building of Type B construction. Therefore, the walls bounding plant rooms that contain central smoke control plant shall achieve FRL 120/120/120.

BCA Clause C3D14(2) states that a main switchboard located within the building which sustains emergency equipment operating in the emergency mode must— (a) be separated from any other part of the building by construction having an FRL of not less than 120/120/120; and (b) have any doorway in that construction protected with a self-closing fire door having an FRL of not less than --/120/120.

BCA Clause C4D15(1) states that the requirements of (2) apply where an electrical, electronic, plumbing, mechanical ventilation, air-conditioning or other service penetrates a building element (other than an external wall or roof) that is required to have an FRL with respect to integrity or insulation or a resistance to the incipient spread of fire.

BCA Clause C4D15(2) states that the installation mentioned in C4D15(1) must comply with any of the following: (a) tested systems; (b) in the case of ventilation or air-conditioning ducts or equipment, the installation is in accordance with AS 1668.1; (c) compliance with Specification 13.

Clause E2D15(2)(a) states that a building “*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*” in a fire compartment with a floor area greater than 2,000 m<sup>2</sup> must be provided with “*an automatic smoke exhaust system complying with Specification 21*”.

Clause S21C7(7) of BCA Specification 21 states that “*power supply wiring to exhaust fans together with detection, control, and indication circuits (and where necessary to automatic make-up air supply arrangements) must comply with AS 1668.1*”.

Clause 4.10.2.1 of AS 1668.1-2015 in part states that wiring systems required to function in fire mode shall meet the fire resistance and mechanical protection requirements of Table 4.1, Appendix D and AS /NZS 3013.

Clause 4.10.2.2 of AS 1668.1-2015 states that apart from wiring systems that serve fire-isolated exit pressurisation systems, any wiring systems serving smoke control equipment listed in Clause 4.10.3 is not required to comply with the fire resistance and mechanical protection requirements of AS/NZS 3013 provided the following cases apply:

- (a) When installed entirely within a plantroom that is fire-isolated from the occupied spaces by construction having FRL not less than --/120/120
- (b) Where loss of voltage cannot adversely affect the operation of the smoke-control system.



Clause 4.10.3 of AS 1668.1-2015 states that electrical components (such as switchgear, control gear, accessories, variable speed drives) associated with smoke control systems (excluding fire-isolated exit systems) shall be fire-isolated from occupied spaces with construction having an FRL not less than --/120/120.

## 12.2 Performance Solution

The Plaza (SZ-02), the Myer retail mall (SZ-03), the Coles wing mall (SZ-01 – not part of this project but may activate during a fire in SZ-02) and the Target wing mall (SZ-04 – not part of this project but may activate during a fire in SZ-02) are provided with dedicated automatic smoke exhaust systems. The layout of smoke exhaust zones is illustrated in Figure 49 below.

The operation of the smoke exhaust systems is supported by multiple existing plant rooms that contain Air Handling Units (AHU) and mechanical service switchboards (MSSB) for smoke exhaust fans (SEF). Also, some MSSBs are located outside plantrooms.

The plant rooms are enclosed with pre-cast concrete panels and reinforced concrete slabs; hence the bounding construction is expected to achieve FRL 120/120/120. The above notwithstanding, some cabling penetrations through the walls are not fire-stopped and the AHU ductwork is not provided with fire dampers where it penetrates fire-rated walls, which does not comply with the DtS provisions of Clause C4D15(2).

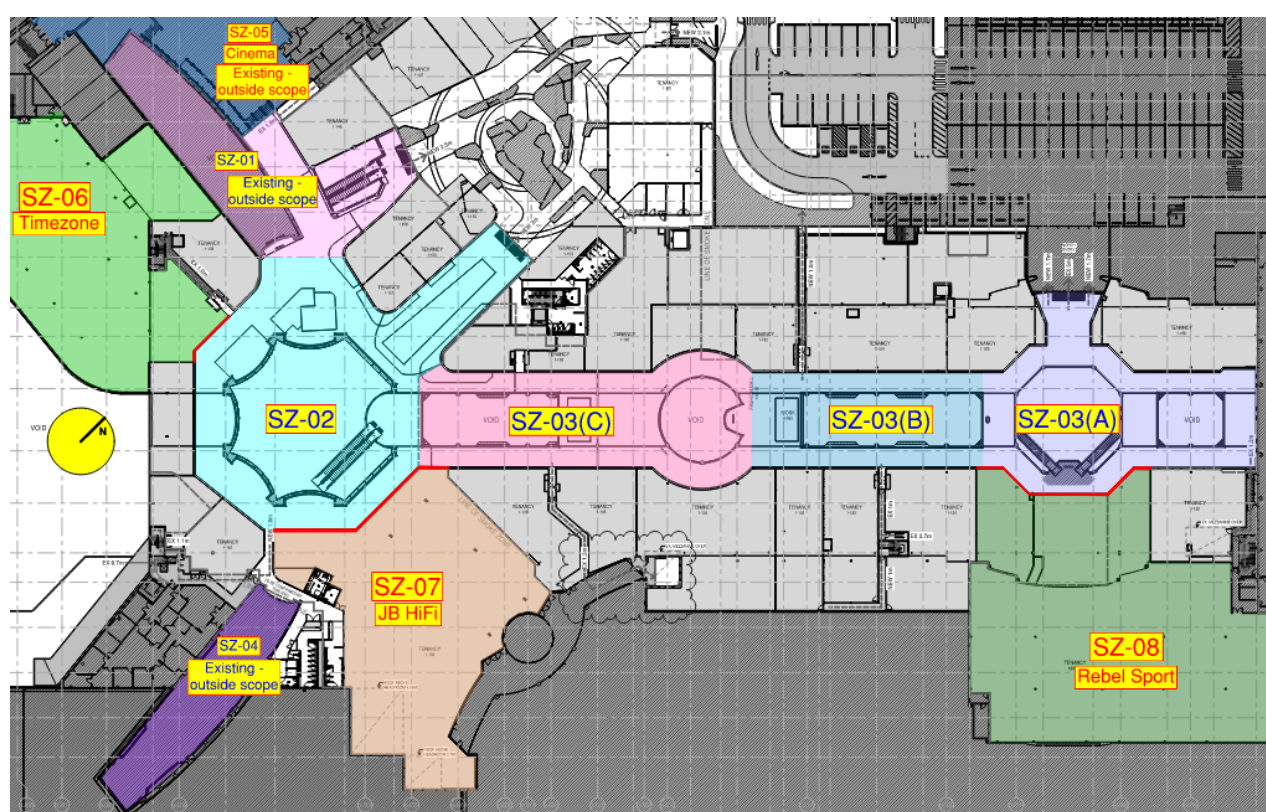


Figure 49: Layout of the smoke exhaust zones on First Floor

The MSSBs located both inside and outside the above plantrooms are not separated from the rest of the building with construction that achieves FRL 120/120/120, which does not comply with the DtS provisions of Clause C3D14(2)(a).

Power supply to the AHUs that provide make-up air to the smoke exhaust systems is provided from the non-essential chassis of the MSSBs and is not fire-rated, which does not comply with the provisions of Clause 4.10.2.2(a) of AS 1668.1-2015 and the DtS provisions of Clause E2D15(2)(a) and Clause S21C7(7) of BCA Specification 21.

### 12.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P2(1)(d) and EP2.2.

### 12.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.

### 12.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to *“minimise the risk of fire spreading through a building that could endanger the occupants, and impede the actions of the fire brigade”*.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient *“time to evacuate before the onset of untenable conditions”*. The Guide to the BCA identifies the untenable conditions as: *“dangerous temperatures, low visibility and dangerous levels of toxicity”*.

It is evident that the main objective of fire rating plant rooms that contain central smoke control plant, including mechanical services switchboards (MSSBs) and power cables to the AHUs that provide make-up to the smoke exhaust system, as well as the MSSBs located external to the plant rooms, is to ensure that during a potential fire the smoke exhaust system operates to a level that facilitates safe occupant evacuation and fire brigade intervention.

### 12.6 Assessment Methodology

The purpose of this assessment is to demonstrate that if a fire compromises one or more plant rooms and/or MSSBs and/or disables one or more AHUs due to non-fire-rated cabling the operation of the smoke exhaust system is not compromised to a point where it would not be able to support safe occupant evacuation and fire brigade intervention.

If it can be demonstrated that a fire that could compromise plant rooms, MSSBs and/or AHUs would not reduce the operational capability of the smoke exhaust system below the critical level, i.e. a level where safe occupant evacuation and fire brigade intervention cannot be facilitated, then compliance with Performance Requirements C1P2(1)(d) and E2P2 is achieved.

The methodology adopted for the assessment is an absolute quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify plant rooms that cannot be considered fire-rated due to service penetrations that are not fire-stopped.
2. Identify where MSSBs supporting the operation of the automatic smoke exhaust system in smoke exhaust zones SZ-02 and SZ-03 are located and to what degree they are fire-separated from the rest of the building.

3. Identify AHUs that are serviced by non-fire-rated cabling.
4. Identify worst-case fire scenarios that could compromise the maximum number of plant rooms, MSSBs and/or AHUs simultaneously.
5. Determine the make-up air volume and smoke exhaust volume that could be lost during the worst-case scenario.
6. Undertake fire and smoke modelling for the worst-case (redundancy) fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).
7. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).
8. Compare the derived ASET and RSET to determine if the design is acceptable.
9. If occupant evacuation and fire brigade intervention with a reduced capacity smoke exhaust system can be facilitated, then compliance with the relevant Performance Requirements is achieved.

#### 12.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *If plant rooms that contain smoke control plant, MSSBs and/or AHUs providing make-up air to the smoke exhaust system are compromised by the fire, the ASET calculated for the redundancy fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$



## 13. Performance Solution No. 3 – Performance-based Non-fire-isolated Exits

### 13.1 Relevant BCA DtS Provisions

BCA Clause D2D5(3)(a) states that in a Class 6 building “no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m”.

The BCA Glossary defines an exit as:

- (c) Any, or any combination of the following if they provide egress to a road or open space:
  - (i) an internal or external stairway; (ii) a ramp; (iii) a fire-isolated passageway; (iv) a doorway opening to a road or open space; or
- (d) A horizontal exit or a fire-isolated passageway leading to a horizontal exit.

### 13.2 Performance Solution

The GSC is provided with multiple non-fire-isolated exits that discharge either into covered carparks on Ground Floor (refer to Figure 50) or under a roofed area on First Floor (refer to Figure 51 below) before they reach a road or open space.

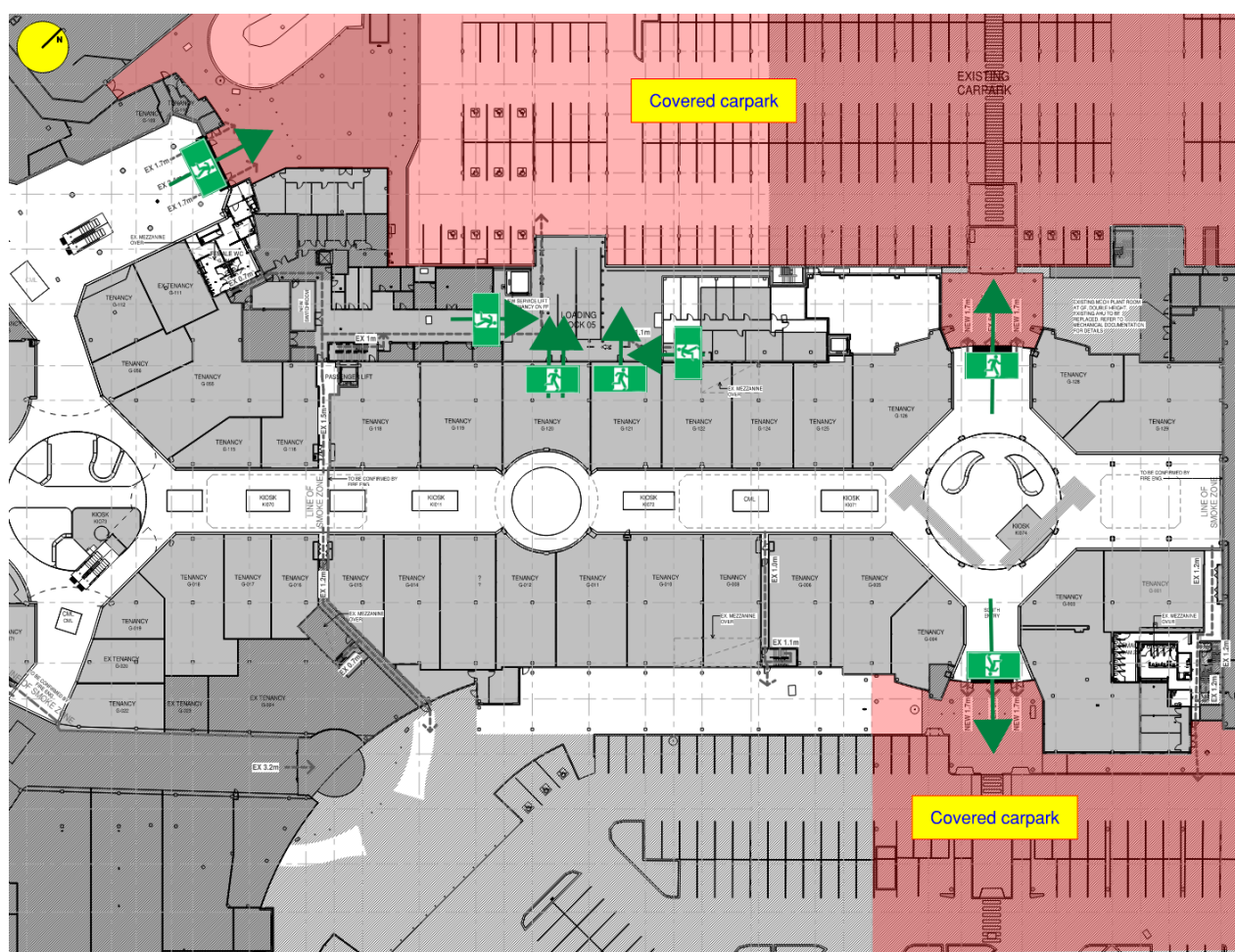


Figure 50: Performance-based non-fire-isolated exits discharging from Ground Floor

Travel distances in this assessment are measured either to internal stairways, fire-isolated passageways and to performance-based non-fire-isolated exits.

Performance-based discharge from internal stairways and fire-isolated passageways is subject of Performance Solution No. 7.

The relevant Performance Requirements have been identified as D1P4 and E2P2.

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. “*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*”.

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.



The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient “*time to evacuate before the onset of untenable conditions*”. The Guide to the BCA identifies the untenable conditions as “*dangerous temperatures, low visibility and dangerous levels of toxicity*”.

It is reasonable to conclude that once a person reaches an exit they should no longer be exposed to dangerous products of combustion and can safely reach a road or open space.

### 13.6 Assessment Methodology

The purpose of this assessment is to demonstrate that doorways that do not discharge directly to a road or open space may be considered performance-based non-fire-isolated exits and that travel distances can be measured to these doors instead of to the edge of the covered carparks on Ground Floor and the roofed area on First Floor.

If it can be demonstrated that during a fire in the retail (Class 6) or entertainment (Class 9b – cinemas) parts of the GSC once occupants leave the fire-affected part they would not be exposed to dangerous products of combustion and can safely evacuate through the covered carparks or under the roofed area, then compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify the non-fire-isolated exits that discharge into the covered carparks and into open spaces from where occupants need to travel either via covered carparks on Ground Floor or under a roofed area on First Floor before they reach a road or open space.
2. Determine whether the spaces where occupants discharge could be compromised by a potential fire in Class 6 or Class 9b parts.
3. Identify fire scenarios that could compromise safe occupant evacuation through the covered carparks and the roofed area on First Floor and determine whether occupants need to evacuate via the fire-affected areas.
4. Determine whether fire brigade is facilitated, i.e. firefighters can connect to external fire hydrants safely before entering the fire-affected areas.

### 13.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Safe occupant evacuation through the covered carparks on Ground Floor and under the roofed area on First Floor shall not be compromised during a potential fire in the Class 6 or Class 9b parts of the GSC.*
2. *Fire brigade intervention shall be facilitated, i.e. shall not be exposed to dangerous products of combustion when they connect to external attack fire hydrants installed in or adjacent to the covered carparks.*

## **14. Performance Solution No. 4 – Extended Travel Distances from Areas not Provided with Automatic Smoke Exhaust**

### **14.1 Relevant BCA DtS Provisions**

BCA Clause D2D5(3)(a) states that in a Class 6 building “*no point on a floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m*”.

### **14.2 Performance Solution**

The following areas within the GSC that are not prescribed to be provided with automatic smoke exhaust have extended travel distances:

1. Travel distances from some specialty shops to a point of choice are extended up to 30 m in lieu of 20 m.
2. Travel distances from parts of the GF north-west BoH area to a point of choice are extended up to 25 m in lieu of 20 m.
3. Travel distances from the GF storage area and plant room AP.ENT adjacent to loading dock 04 to a point of choice are extended up to 30 m in lieu of 20 m.
4. Travel distances from the GF storage area (north-west BoH) to a single exit are extended up to 30 m in lieu of 20 m.
5. Travel distances from FF amenities (Male Amenities 1.AM.11, Parent Room 1.AM.0, Female Amenities 1.ST.03 and Male Amenities 1.ST.24) to a point of choice are extended up to 27 m in lieu of 20 m.
6. Travel distances from the GF BoH area to the nearest of the alternative exits are extended up to 50 m.

The dead-end travel distances therefore do not comply with the DtS provisions of Clause D2D5(3)(a).

### **14.3 Relevant Performance Requirements**

The relevant Performance Requirement has been identified as D1P4 and E2P2.

### **14.4 Assessment Method**

The assessment method adopted is BCA Assessment Method A2G2(2)(d), i.e. “*comparison with the Deemed-to-Satisfy Provisions*”.

### **14.5 Intent of the BCA**

The intent of Performance Requirement D1P4 (formerly DP4), in accordance with the Guide to the BCA that provides explanation and interpretation of some of the BCA DtS provisions [ABCB, 2020], is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient “*time to evacuate before the onset of untenable conditions*”. The Guide to the BCA identifies the untenable conditions as “*dangerous temperatures, low visibility and dangerous levels of toxicity*”.

It is evident that time plays a crucial role in safe occupant evacuation. The overall evacuation time consists of three (3) main components: detection time, pre-movement (response) time and egress (movement) time. Generally, if the egress time is increased due to extended travel distances, the detection and/or pre-movement times must be reduced to facilitate safe occupant evacuation.

#### 14.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to a point of choice or a single exit should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

The level of fire safety inherent in a BCA DtS compliant design represents an acceptable community standard for new building works in Australia.

If it can be demonstrated that in the performance-based design the RSET is shorter than in a BCA DtS complaint design, compliance with Performance Requirements D1P4 and E2P2 is achieved on a comparative basis.

The methodology adopted for the assessment is a quantitative and qualitative comparative analysis in accordance with the following:

1. In consultation with the building surveyor develop and document a hypothetical reference base case design that complies with the BCA DtS provisions and document the characteristics of the performance-based design. These designs are detailed in Table 23 below.
2. Calculate the detection time for the BCA DtS compliant design using module ‘Sprinkler’ from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with standard response sprinkler heads installed on a 3.0 m x 4.0 m grid.
3. Calculate the detection time for the performance-based design (areas where provision of smoke detectors may cause spurious alarms) using module Sprinkler from the FireWind 3.6 suite of fire safety engineering software. The detection time is based on the activation of automatic fire sprinkler system installed to AS 2118.1 and fitted with fast response sprinkler heads installed on a 3.0 m x 4.0 m grid.
4. Calculate the detection time for the performance-based design (specialty shops, amenities and “clean” BoH areas) using program CFAST. The detection time is based on the activation of fire detection and alarm system installed to AS 1670.1 and fitted with smoke detectors installed on a 10.0 m x 10.0 m grid.
5. Calculate travel times for the BCA DtS compliant design and the performance-based design.
6. Determine RSET for the BCA DtS compliant design and the performance-based design.

- Compare RSET for the BCA DtS compliant design and the performance-based design. If the RSET for the performance-based design is less than or equal to that of the BCA DtS compliant design, then the relevant Performance Requirements of the BCA are satisfied.

#### 14.7 Comparative Characteristics

The comparative characteristics of the BCA DtS compliant design and the performance-based design are summarised in Table 23 below:

| Item                                                                 | BCA DtS compliant design                                                                        | Performance-based design                                                                                                                                                                                        |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Building classification                                              | Class 6 (Retail)                                                                                |                                                                                                                                                                                                                 |
| Floor-to-ceiling height                                              | 3.6 m to 9.4 m                                                                                  |                                                                                                                                                                                                                 |
| Maximum travel distance to a point of choice or to a single exit     | 20 m                                                                                            | 30 m                                                                                                                                                                                                            |
| Maximum travel distance to the nearest of the alternative exits      | 40 m                                                                                            | 50 m                                                                                                                                                                                                            |
| Fire suppression                                                     | Automatic sprinkler system to AS 2118.1-1999                                                    |                                                                                                                                                                                                                 |
|                                                                      | Standard response sprinkler heads on a 3.0 m x 4.0 m grid                                       | Fast response sprinkler heads on a 3.0 m x 4.0 m grid (where smoke detectors could cause spurious alarms)                                                                                                       |
| Fire detection and alarm in specialty shops, amenities and BoH areas | Automatic fire sprinkler system to AS 2118.1-1999 with <u>standard response</u> sprinkler heads | Smoke detectors to Clause S20C4 of BCA Specification 20; and<br>Automatic fire sprinkler system to AS 2118.1-1999 with <u>fast response</u> sprinkler heads (where smoke detectors could cause spurious alarms) |
| Smoke exhaust                                                        | Not prescribed and not provided                                                                 |                                                                                                                                                                                                                 |
| Building occupant warning                                            | Building occupant warning to Clause 6 of BCA Spec. 20 and AS 1670.1-2018                        | EWIS to Clause E4D9(d) and AS 1670.4-2018                                                                                                                                                                       |

Table 23: Comparative characteristics for the BCA DtS compliant design and the performance-based design

#### 14.8 Acceptance Criteria

The acceptance criterion for this assessment is:

- RSET for the performance-based design shall be less or equal to the RSET for the BCA DtS compliant design:

$$RSET (\text{performance-based design}) \leq RSET (\text{BCA DtS compliant design}).$$

#### 14.9 Fire Scenarios

An important factor of a fire safety engineering assessment is identifying appropriate fire scenarios.

Extended travel distances are present in areas that may have different fire growth rates that may vary from 'medium' in amenities to 'ultra-fast' in some stores. Therefore, 'medium' and 'ultra-fast' t-squared growth fire rates are considered.

For the purpose of this comparative analysis the fire scenarios detailed in Table 24 were assessed.

| Fire Scenario                                                            | Location of Fire                                                                | Fire Description                                                                                                                                  |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BCA DtS compliant designs</b>                                         |                                                                                 |                                                                                                                                                   |
| BCD-11                                                                   | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Medium' t-squared growth rate fire.<br>Detection by <u>standard response</u> sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid     |
| BCD-12                                                                   | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Ultra-fast' t-squared growth rate fire.<br>Detection by <u>standard response</u> sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid |
| BCD-21                                                                   | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Medium' t-squared growth rate fire.<br>Detection by <u>standard response</u> sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid     |
| BCD-22                                                                   | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Ultra-fast' t-squared growth rate fire.<br>Detection by <u>standard response</u> sprinkler heads installed to AS2118.1-1999 on a 3 m by 4 m grid |
| <b>Performance-based designs – sprinkler detection / smoke detection</b> |                                                                                 |                                                                                                                                                   |
| PBD-11-Spkl                                                              | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Medium' t-squared growth rate fire.<br>Detection by <u>fast response</u> sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid              |
| PBD-12-Spkl                                                              | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Ultra-fast' t-squared growth rate fire.<br>Detection by <u>fast response</u> sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid          |
| PBD-21-Spkl                                                              | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Medium' t-squared growth rate fire.<br>Detection by <u>fast response</u> sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid              |
| PBD-22-Spkl                                                              | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Ultra-fast' t-squared growth rate fire.<br>Detection by <u>fast response</u> sprinkler heads installed to AS2118.1 on a 3 m by 4 m grid          |
| PBD-11-SD                                                                | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Medium' t-squared growth rate fire.<br>Detection by smoke detectors installed to AS1670.1-2015 on a 10 m by 10 m grid                            |
| PBD-11-SD                                                                | Fire occurs under a 2.8 m high ceiling/soffit (lowest floor-to-ceiling height)  | 'Ultra-fast' t-squared growth rate fire.<br>Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid                             |
| PBD-21-SD                                                                | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Medium' t-squared growth rate fire.<br>Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid                                 |
| PBD-22-SD                                                                | Fire occurs under a 6.0 m high ceiling/soffit (highest floor-to-ceiling height) | 'Ultra-fast' t-squared growth rate fire.<br>Detection by smoke detectors installed to AS1670.1 on a 10 m by 10 m grid                             |

Table 24: Summary of the fire scenarios



## 15. Performance Solution No. 5 – Performance-based Egress and Smoke Hazard Management Provisions in the Retail Malls

### 15.1 Relevant BCA DtS Provisions

The BCA sets out the following DtS requirements regarding travel distances and smoke hazard management systems:

1. Clause D2D5(3)(a) states that in a Class 5 to 9 building *“no point on the floor must be more than 20 m from an exit, or a point from which travel in different directions to 2 exits is available, in which case the maximum distance to one of those exits must not exceed 40 m”*.
2. Clause D2D6(c)(iii) states that in a Class 6 building the maximum distance between the alternative exits must not exceed 60 m.
3. Clause E2D15(2)(a) states that a building *“containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit”* in a fire compartment with a floor area greater than 2,000 m<sup>2</sup> must be provided with *“an automatic smoke exhaust system complying with Specification 21”*.
4. Clause S21C2(2) of BCA Specification 21 state that smoke *“exhaust rates must be determined in accordance with Figure S21C2, with the height measurement taken from the lowest floor level to the underside of the smoke layer and the fire load determined in accordance with Table S21C2”*.
5. Clause S21C4(2) of BCA Specification 21 states that *“the horizontal area of a smoke reservoir must not exceed 2,000 m<sup>2</sup> and in enclosed walkways or malls of a Class 6 building must not exceed 60 m in length”*.
6. Clause S21C6(3) of BCA Specification 21 states that *“within a multi-storey fire compartment, make-up air must be provided across each vertical opening from a building void to the fire-affected storey at an average velocity of 1 m/s so as to minimise the spread of smoke from the fire-affected storey to other storeys”*.

### 15.2 Performance Solution

The GSC is provided with multiple exits around the perimeter of the building. The multiple escape paths notwithstanding, egress provisions from parts of the centre that are prescribed to be provided with automatic smoke exhaust and from tenancies with paths of travel via areas that are prescribed to be provided with automatic smoke exhaust, and some smoke hazard management provisions, do not achieve full compliance with the BCA DtS provisions as outlined below.

1. Travel distances to the nearest of the alternative exits in multiple areas are extended up to 61 m in lieu of 40 m (refer to Figure 52 and Figure 53 below), which does not comply with the DtS provisions of BCA Clause D2D5(3)(a).
2. Distances between the alternative exits, when measured through a point of choice, are extended up to 118 m in lieu of 60 m (refer to Figure 54 and Figure 55 below), which does not comply with the DtS provisions of BCA Clause D2D6(c)(iii). When distances are measured between an exit and a “place of intermediate safety” or between “places of intermediate safety” they are extended only up to 86 m.



Figure 52: Travel distances to the nearest of alternative exits on Ground Floor

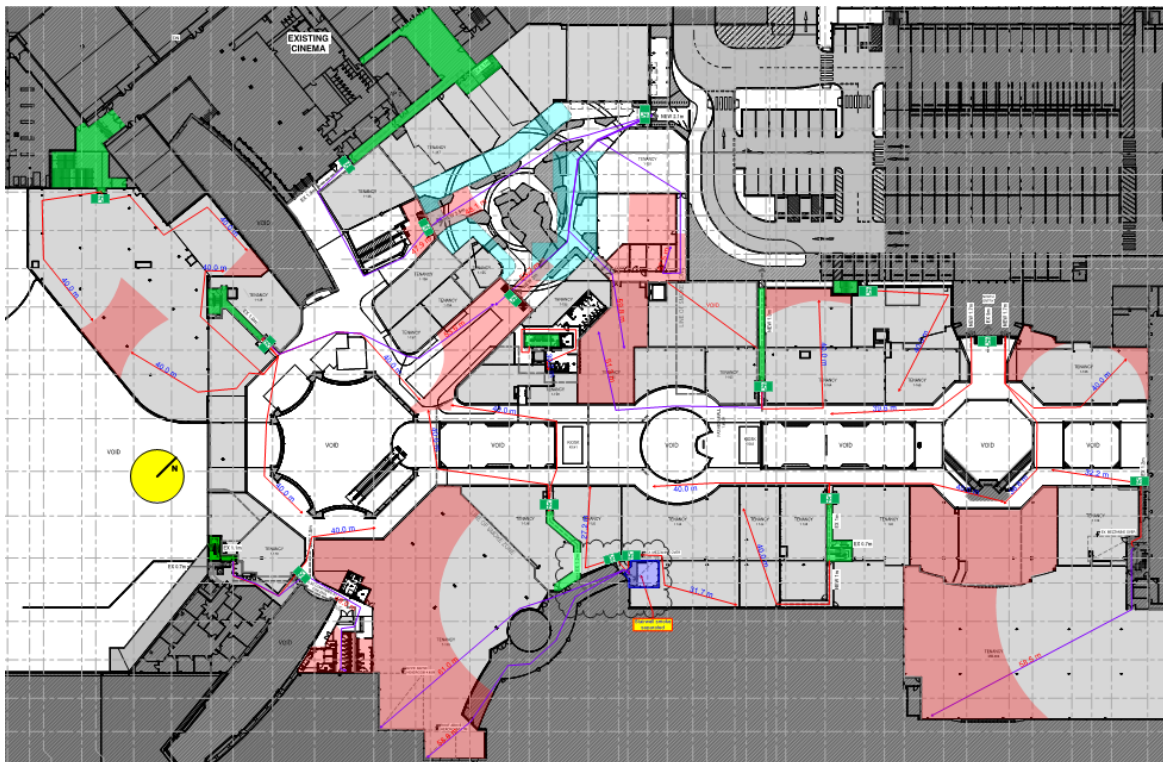


Figure 53: Travel distances to the nearest of alternative exits on First Floor



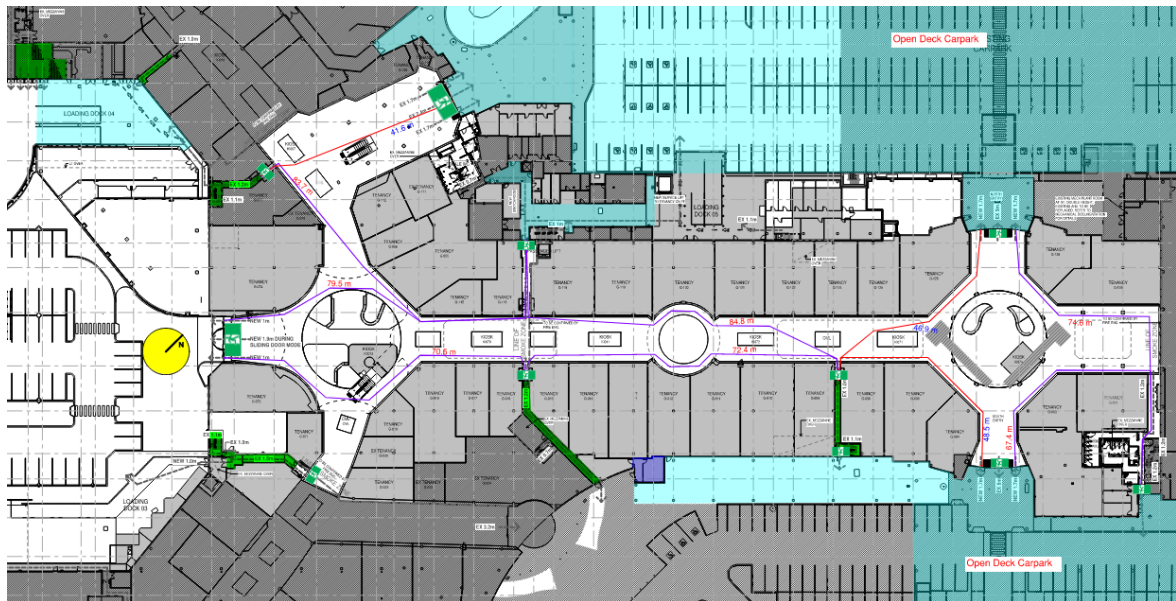


Figure 54: Distances between alternative exits when measured through a point of choice on Ground Floor

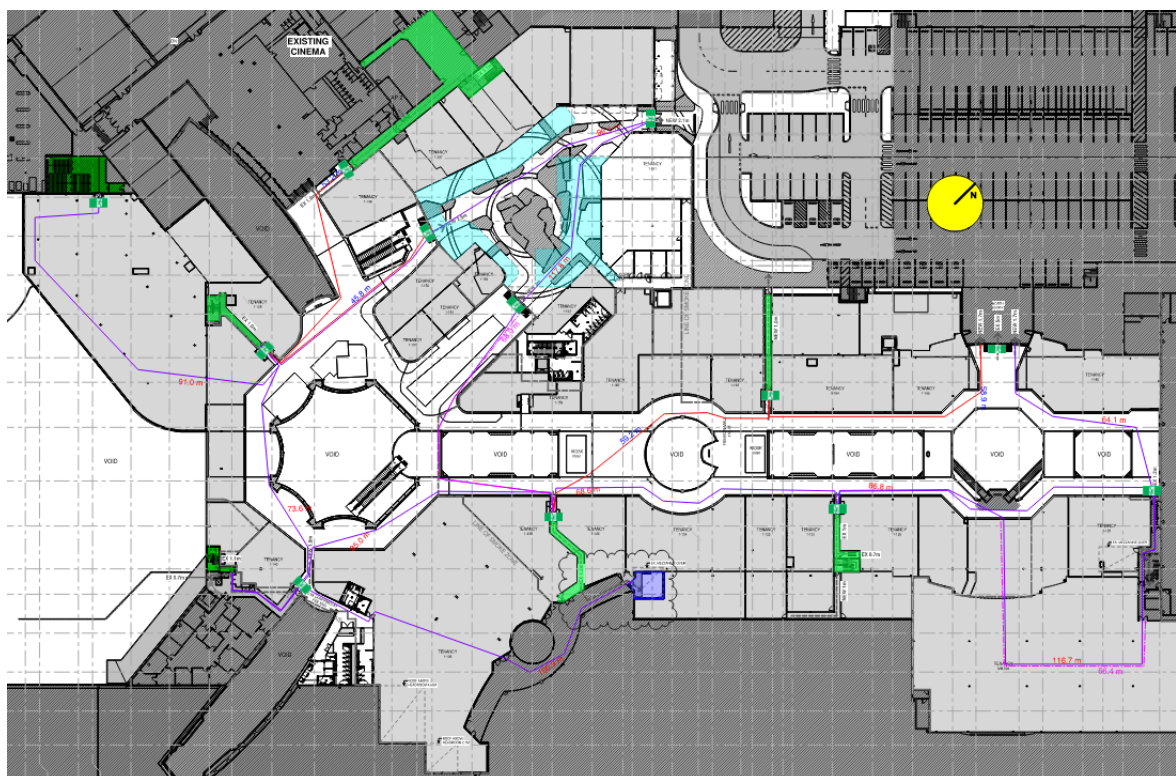


Figure 55: Distances between alternative exits when measured through a point of choice on First Floor

3. The smoke exhaust rates for the Myer retail mall and the Plaza (refer to the configuration of smoke zones as shown in Figure 56 below) are determined on a performance basis in lieu of compliance with Figure S21C2, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C2(2) of BCA Specification 21.
4. The Myer retail mall (smoke zones SZ-03(A), SZ-03(B) and SZ-03(C)) forms a single smoke reservoir with a horizontal length of 144 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.

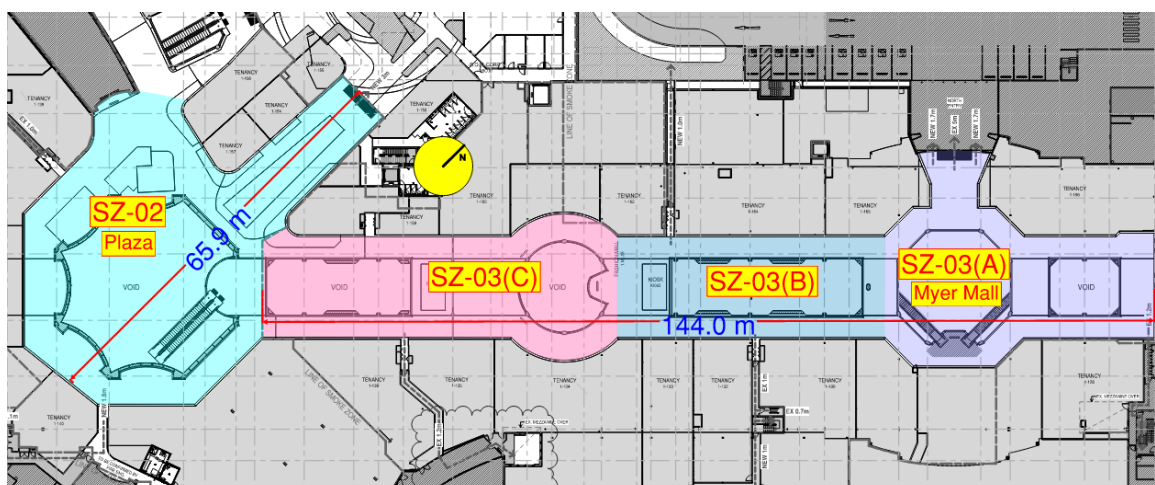


Figure 56: Extended length of smoke reservoirs

5. The Plaza and the associated retail mall (smoke zone SZ-02) form a single smoke reservoir with a horizontal length of 66 m in lieu of 60 m, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C4(2) of BCA Specification 21.
6. Make-up air velocities through vertical openings are determined on a performance basis in lieu of achieving an average velocity of 1 m/s, which does not comply with the DtS provisions of Clauses E2D15(2)(a) and S21C6(3) of BCA Specification 21.

### 15.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P4 and E2P2.

### 15.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e., “*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*”.

### 15.5 Intent of the BCA

The intent of Performance Requirement D1P4 is to provide sufficient number of exits that are properly sized and distributed to facilitate safe occupant evacuation.

The intent of Performance Requirement E2P2 is to provide occupants with sufficient “*time to evacuate before the onset of untenable conditions*”. The Guide to the BCA identifies the untenable conditions as: “*dangerous temperatures, low visibility and dangerous levels of toxicity*”.

It is evident that for a successful completion of an emergency evacuation a building must be provided with a smoke hazard management system that is appropriately sized and exits that are adequately located, sized and designed so as to provide occupants with safe means of egress from the fire affected areas.

The Guide states regarding the smoke reservoir size that the purpose of specifying maximum smoke reservoir size is because *“smoke reservoirs are necessary to contain the hot layer in the upper levels of compartments, thus preventing the lateral spread of smoke resulting in excessive cooling and downward mixing of the smoke with the relatively clear layer below”* and that in doing so, the design:

- *“enables occupants to make their way through the comparatively clear air below the hot smoke layer; and*
- *“maintains the smoke above any openings between compartments, thus minimising the risk that smoke will migrate to other areas.”*

The Guide further states that *“to maximise the effectiveness of smoke reservoirs, the horizontal area formed by a reservoir is limited by Clause S21C4(2) to 2,000 m<sup>2</sup>”* and that *“the maximum length of a smoke reservoir in a shopping mall is limited by Clause S21C4(2) to 60 metres, due to the distance people would be expected to travel below a smoke layer while evacuating to a safe place, having regard to the potential for smoke, from a fire in a mall or adjacent specialty shop, to flow into more than one reservoir.”*

The relevant BCA DtS provisions are intended to maintain tenable conditions so that occupants can evacuate and therefore if a building is provided with fire safety measures designed to maintain conditions tenable in the evacuation routes for the duration of the evacuation, including adequate safety factors, occupants should be able to leave the building safely, which satisfies the relevant Performance Requirements.

### 15.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design with extended travel distances to the nearest of the alternative exits and extended distances between the alternative exits in the parts of the GSC that are prescribed to be provided with automatic smoke exhaust, and a performance-based smoke hazard management system in the retail malls should not compromise safe occupant evacuation and should not adversely affect fire brigade intervention.

If it can be demonstrated that during a fire in the retail mall or in a specialty shop not provided with smoke exhaust the installed fire safety measures are capable of maintaining tenable conditions in the escape paths for a period of time sufficient for all occupants to leave the GSC, and fire brigade intervention is facilitated, compliance with Performance Requirements D1P4 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute quantitative deterministic assessment in accordance with the following:

1. Analyse the proposed egress provisions for the GSC identifying all exits, including exits directly to the outside of the building; fire-isolated stairways and corridors; etc.
2. Analyse the smoke hazard management systems in the retail malls, including the type of automatic fire sprinkler and fire detection and alarm systems, and the mechanical smoke exhaust and make-up air supply systems.
3. Identify reasonable worst-credible design fire scenarios, specifying the locations of fires that are expected to have the worst impact on occupant evacuation and fire brigades' intervention.



4. Identify reasonable worst credible sensitivity and/or redundancy fire scenarios. Fire brigade intervention for the sensitivity and redundancy fire scenarios is not considered, as the size of an uncontrolled fire could be beyond the extinguishing capacity of the first arriving units and would require multiple alarms transmitted to be brought under control. DFES operations in the early stages of sensitivity and redundancy fire scenarios are expected to be limited to search and rescue (if conditions permit) and/or protection of exposures.
5. Undertake fire and smoke modelling for the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria.
6. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters.
7. Compare the derived ASET and RSET to determine if the design is acceptable.

### 15.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *ASET calculated for the design fire scenarios must be equal to or greater than the RSET for the design fire scenarios incorporating a safety factor of 1.5:*

$$ASET \geq 1.5 \times RSET$$

2. *ASET calculated for the redundancy and sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

3. *Routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*

### 15.8 Fire Scenarios Selection

The ASET is dependent on the fire characteristics, such as the fire growth rate, the heat release rate, the soot yield, the species concentrations, and the location of a fire. Therefore, an important factor in a fire safety engineering assessment is identifying appropriate fire scenarios.

The derivation of fire parameters (such as soot yield and heat release rate) is discussed in Section 10.3. It is recognised that modelling every possible fire location is not practical, however, the fire locations chosen are considered worst credible locations and appropriate for the analysis. The fire locations are discussed in Table 25 and are shown in Figure 57 below.

| Fire Location |                                                                           | Comment                                                                                                                                                                                                              |
|---------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1             | DF-01/RF-01/SF-01<br>In the Plaza atrium                                  | A fire located under the Plaza atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread.                            |
| 2             | DF-02/RF-02/SF-02<br>In the Myer Mall GF circulation space under the void | A fire located in the Myer Mall circulation space under the void is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread. |

| Fire Location |                                              | Comment                                                                                                                                                                                       |
|---------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3             | DF-03/RF-03/SF-03<br>In the Myer Mall atrium | A fire located under the Myer Mall atrium is considered a worst credible fire location as this may result in the worst air entrainment and in greater levels of smoke development and spread. |

Table 25: Fire locations



Figure 57: Fire locations

Based on the above fire locations, the discussion provided in Section 10.5 and accounting for the redundancy and sensitivity fire scenarios, the summary of fire scenarios that are assessed as part of this Performance Solution are provided in Table 26.

| Fire scenario | Fire Location                                                 | Fire growth rate               | Comment                                                |
|---------------|---------------------------------------------------------------|--------------------------------|--------------------------------------------------------|
| WW-DF-01      | In the Plaza Atrium – under 20.6 m high roof                  | Fast $t^2$ to medium $t^2$     | Design fire scenario                                   |
| WW-RF-01      |                                                               | Fast $t^2$ to medium $t^2$     | Redundancy scenario – single plant room failure        |
| WW-SF-01      |                                                               | Ultra-fast $t^2$ to fast $t^2$ | Sensitivity fire scenario – increased fire growth rate |
| WW-DF-02      | In the Myer Mall GF circulation space – under 8.8 m high roof | Fast $t^2$ to medium $t^2$     | Design fire scenario                                   |
| WW-RF-02      |                                                               | Fast $t^2$ to medium $t^2$     | Redundancy scenario – single plant room failure        |
| WW-SF-02      |                                                               | Ultra-fast $t^2$ to fast $t^2$ | Sensitivity fire scenario – increased fire growth rate |
| WW-DF-03      | In the Myer Mall Atrium – under 25.5 m high roof              | Fast $t^2$ to medium $t^2$     | Design fire scenario                                   |
| WW-RF-03      |                                                               | Fast $t^2$ to medium $t^2$     | Redundancy scenario – single plant room failure        |
| WW-SF-03      |                                                               | Ultra-fast $t^2$ to fast $t^2$ | Sensitivity fire scenario – increased fire growth rate |

Table 26: Fire scenarios for the assessment

## 16. Performance Solution No. 6 – Performance-based Access to Fire-Isolated Corridor 03

### 16.1 Relevant BCA DtS Provisions

BCA Clause D2D12(1) states that “a doorway from a room must not open directly into a passageway that is required to be fire-isolated unless it is from: a public corridor, public lobby or the like; a sole-occupancy unit occupying all of a storey; or a sanitary compartment, airlock or the like”.

### 16.2 Performance Solution

The existing security room that does not occupy the whole of a storey opens directly into the Ground Floor fire-isolated corridor 03 (G.BO.03), as shown in Figure 58, which does not comply with the DtS provisions of Clause D2D12(1).

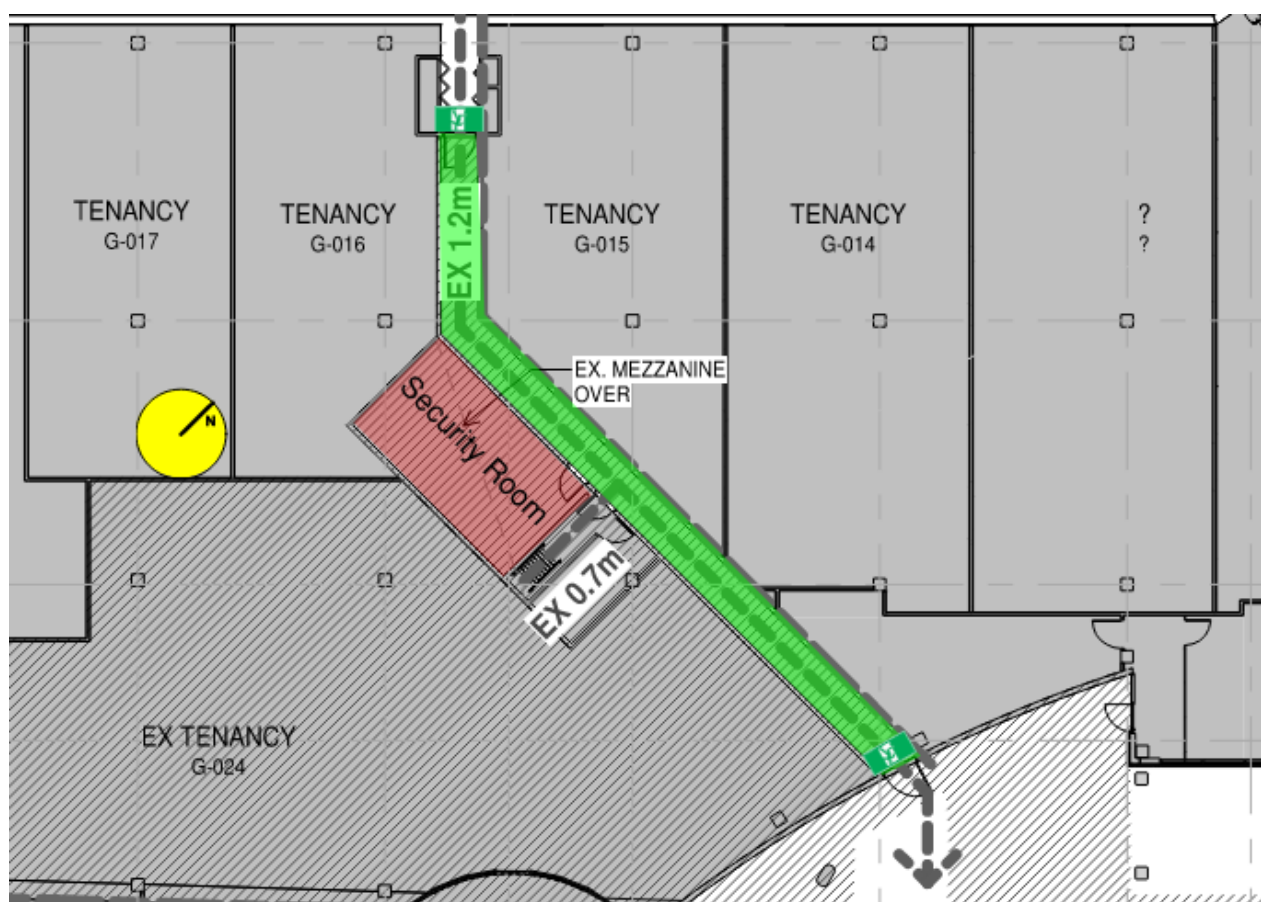


Figure 58: Security room open directly into fire-isolated corridor 03

### 16.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as D1P5 and E2P2.

### 16.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. “other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”.

## 16.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- *“Enable people to evacuate safely past a storey on fire;*
- *“Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting;*
- *“Minimise the distance people need to travel in a fire affected area before they are able to access a “safe place”, such as a fire-isolated stairway.”*

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient *“time to evacuate before the onset of untenable conditions”*. The Guide to the BCA identifies the untenable conditions as *“dangerous temperatures, low visibility and dangerous levels of toxicity”*.

It is evident from the above that fire-isolated exits are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade’s personnel fast and safe access to these areas. However, to understand how doorways opening directly into a fire-isolated exit from a room that does not occupy the whole storey could impact safe evacuation of the occupants the intent of Clause D2D12(1) (formerly D1.7(a)) must be understood.

The Guide to the BCA indicates that the intent of Clause D1.7 is *“to enable occupants to safely enter a fire-isolated exit which discharges to a safe location”*, and the intent of sub-clause (a) is *“to limit the number of entry points into a fire-isolated exit to retain its fire resisting performance”*.

The BCA DtS provisions allow a public corridor, public lobby [smoke lobby], or the like, as well as a *“sole-occupancy unit occupying all of a storey”* to open directly into a fire-isolated exit. It is reasonable to assume that a public corridor and to a lesser degree a retail mall in a shopping centre should have a performance that is not dissimilar to that of a smoke lobby, as they are reasonably free of combustible materials and create a buffer between the fire affected area and a fire-isolated exit. However, it is not clear why a *“sole-occupancy unit occupying all of a storey”* can open directly into a fire-isolated exit and one that does not, cannot provide direct access. The Guide to the BCA remains silent on this issue.

It is understood that independent of a floor/storey configuration the main intent of the BCA in relation to access to fire-isolated exits is to protect occupants using these exits from dangerous combustion products, so the building can be evacuated safely. This can be achieved only if the doors to fire-isolated exits remain closed and an effective barrier to smoke spread is provided.

It is understood that the main concern of the BCA, as reflected in Clause D1.7(a), is that sole-occupancy units that do not occupy the whole of a storey are generally smaller tenants, who may not be concerned with keeping the door to the fire-isolated exit closed, as they may use it regularly to move stock, access other parts of the building, or even use it for ventilation. Hence with several smaller tenants occupying the same floor/storey the risk of a door being left open multiplies.

Sole-occupancy units occupying the whole of a storey are generally major tenants who take particular care of their security arrangements. In such tenancies the likelihood of a door opening into a fire-isolated exit being left open is significantly reduced, as keeping a door properly closed becomes self-regulatory due to security reasons.

## **16.6 Assessment Methodology**

The purpose of this assessment is to demonstrate that safe occupant evacuation of building occupants and fire brigade intervention should not be compromised due to a room that does not occupy the whole of a storey opening directly into a fire-isolated corridor.

If it can be demonstrated that during a potential fire occupants from the existing security room and MDF room on Ground Floor and from the existing plant room AP7 on Ground Floor Mezzanine can evacuate safely via fire-isolated corridor 03 and occupants elsewhere in the GSC are provided with adequate warning that evacuation via fire-isolated corridor 03 should be avoided, and fire brigade personnel are provided with alternative access routes to the fire affected area, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify the doorway that opens into fire-isolated corridor 03 directly from a room that does not occupy a whole storey.
2. Identify occupants who have to or may be evacuating via fire-isolated corridor 03.
3. Develop a fire safety strategy that would limit the potential for smoke spread into fire-isolated corridor 03 in the initial stages of fire development and would also enable occupants from other rooms and parts of the GSC either to evacuate via the corridor safely or avoid evacuation via this corridor altogether.
4. Identify alternative access routes for fire brigade and determine whether their intervention is facilitated.
5. If the adopted fire safety strategy limits the potential for smoke spread into fire-isolated corridor 03, provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

## **16.7 Acceptance Criteria**

The acceptance criteria for this assessment are:

1. *Smoke from security room shall not spread into fire-isolated corridor 03 in the initial stages of fire development.*
2. *Occupants who have to evacuate via fire-isolated corridor 03 shall be provided with timely and adequate warning that tenability conditions in the corridor may be quickly compromised due to a fire in the security room.*
3. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridor 03 may not be safe and alternative escape routes shall be used.*



4. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridor 03.*

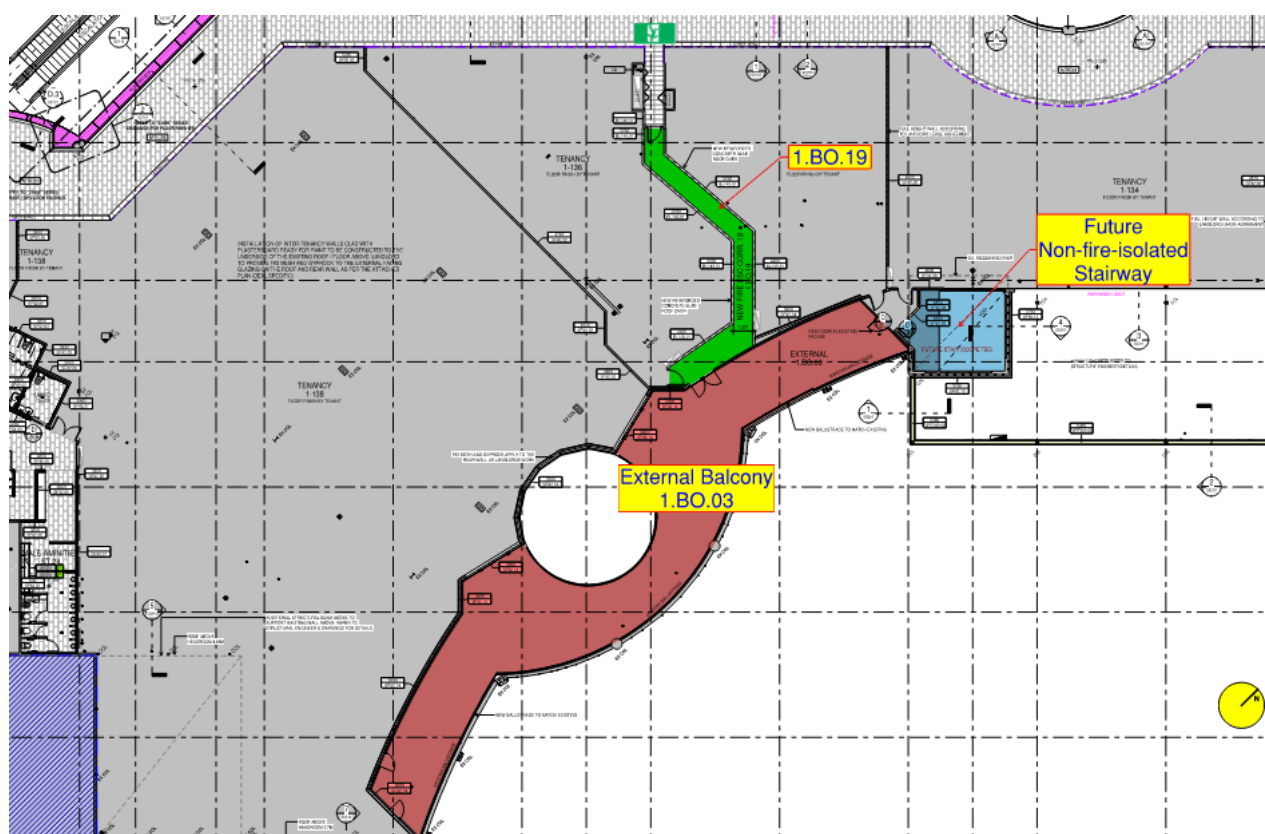
## 17. Performance Solution No. 7 – Performance-based Discharge from Fire-Isolated Exits

### 17.1 Relevant BCA DtS Provisions

BCA Clause D2D12(2) in part states that “each fire-isolated stairway or fire-isolated ramp must provide independent egress from each storey served and discharge directly, or by way of its own fire-isolated passageway— (a) to a road or open space; or (b) to a point— (i) in a storey or space, within the confines of the building, that is used only for pedestrian movement, car parking or the like and is open for at least 2/3 of its perimeter; and (ii) from which an unimpeded path of travel, not further than 20 m, is available to a road or open space”.

### 17.2 Performance Solution

First floor fire-isolated corridor 19 (1.BO.19) discharges to an external balcony (1.BO.03) from where occupants need to use a required non-fire-isolated stairway to leave the building (refer to Figure 59) in lieu of to a road or open space, which does not comply with the DtS provisions of Clause D2D12(2)(a).



[illegible]

Page 111

### 17.5 Intent of the BCA

The intent of Performance Requirement D1P5 (formerly DP5) is to provide fire-isolated exits, where necessary, to facilitate safe evacuation of occupants and fire brigade intervention. The Guide to BCA states that fire-isolated exits are used to:

- *“Enable people to evacuate safely past a storey on fire;*
- *“Facilitate fire brigade access to carry out operations such as search and rescue and fire-fighting;*
- *“Minimise the distance people need to travel in a fire affected area before they are able to access a “safe place”, such as a fire-isolated stairway.”*

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient *“time to evacuate before the onset of untenable conditions”*. The Guide to the BCA identifies the untenable conditions as *“dangerous temperatures, low visibility and dangerous levels of toxicity”*.

It is evident from above that fire-isolated exits in a building are required to provide occupants with safe means of egress while reducing the time they might have to travel through the fire affected areas, as well as facilitating fire brigade’s personnel fast and safe access to these areas.

The Guide to the BCA indicates that the intent of Clause D2D12 (formerly D1.7) is *“to enable occupants to safely enter a fire-isolated exit which discharges to a safe location”*. While the BCA allows fire-isolated exits to discharge into semi-enclosed parts of the building provided with adequate openings *“to aid smoke ventilation”*, the path of travel from the point of discharge of a fire-isolated exit must be adequately protected from combustion products so occupants may reach a road or open space safely.

### 17.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based design should facilitate safe occupant evacuation and fire brigade intervention even though some fire-isolated exits discharge into areas that do not comply with the BCA DtS provisions.

It is considered that if it can be demonstrated that occupants do not have to evacuate via the fire-escape corridors that discharge into areas that do not comply with the BCA DtS provisions if a fire starts in those areas, and alternative escape paths that would facilitate safe occupant evacuation are available, and fire brigade personnel are provided with alternative access routes, then compliance with Performance Requirements D1P5 and E2P2 is achieved.

The methodology adopted for the assessment is an absolute qualitative deterministic analysis in accordance with the following:

1. Identify where fire-isolated exits discharge into non-compliant locations and assess the configuration of those spaces.
2. Identify fire scenarios that could occur in those spaces, and whether they could compromise safe occupant evacuation from the fire-isolated exits.
3. Identify occupants who have to or may be evacuating via the subject fire-isolated exits.

4. Develop a fire safety strategy that would allow occupants from the rooms that discharge into the subject fire-isolated exits and from other parts of the GSC to evacuate the building safely.
5. Identify alternative access routes for fire brigade intervention and determine whether their intervention is facilitated.
6. If the adopted fire safety strategy provides an adequate warning to occupants that would enable them to evacuate safely and facilitates fire brigade intervention, then compliance with the relevant Performance Requirements of the BCA is achieved.

#### **17.7 Acceptance Criteria**

The acceptance criteria for this assessment are:

1. *Occupants from plant room AP4 on Ground Floor Mezzanine and from Tenancy 1-144 on First Floor shall be provided with timely and adequate warning that conditions in Loading Dock 04 may not be tenable and evacuation via fire-isolated corridors 06 and 15 may not be safe and shall be provided with an alternative escape path.*
2. *Occupants in other parts of the GSC shall be provided with adequate warning that evacuation via fire-isolated corridors 06, 15, 19 and 20 may not be safe and alternative escape routes shall be used.*
3. *Fire brigade shall be provided with alternative access routes to the GSC that do not involve travel via fire-isolated corridors 06, 15, 19 and 20.*



## 18. Performance Solution No. 8 – Performance-based Fire Hydrant System

### 18.1 Relevant BCA DtS Provisions

BCA Clause E1D2(2) states that a fire hydrant system must be installed to AS 2419.1-2021.

Clause 3.5.1(b) of AS 2419.1-2021 states that where external fire hydrants are installed, fire hydrant coverage from an external attack fire hydrant shall be used to achieve coverage to the lowest four storeys included in the calculation of the rise in storeys in compliance with the DtS provisions of the NCC and the storey immediately below these storeys, provided all parts of the building are covered.

Clause 3.5.1(c) of AS 2419.1-2021 states that where all parts of the building are not covered by external hydrants in accordance with (b), internal fire hydrants located in accordance with Clause 3.6.2 shall be installed to provide coverage to those parts of the building not protected by external fire hydrants.

Clause 3.5.3.3(a)(i) of AS 2419.1-2021 states that each external attack fire hydrant shall be located not more than 50 m from a fire brigade pumping appliance located on a hardstand.

Clause 3.5.3.3(a)(ii) of AS 2419.1-2021 states that each external attack fire hydrant shall be located less than 100 m from a fire brigade pumping appliance located on a hardstand when providing fire hydrant protection from— (A) a podium; (B) to a building that is provided with a sprinkler system conforming to AS 2118.1; and (C) to a Class 9c building.

Clause 3.5.3.3(b) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(i) (not more than 50 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 70 m from the external attack fire hydrant.

Clause 3.5.3.3(c) of AS 2419.1-2021 states that all parts of a building that are protected by an external attack fire hydrant located in accordance with Item (a)(ii) (less than 100 m from a fire brigade pumping appliance located on a hardstand), shall be not more than 40 m from the external attack fire hydrant.

Clause 3.6.1(e) of AS 2419.1-2021 states that where internal fire hydrants are installed, all parts of the floor shall not be more than 40 m from an internal fire hydrant installed in accordance with Clause 3.6.2.

Clause 3.6.2(a)(ii) of AS 2419.1-2021 states that where fire-isolated exits are provided, internal fire hydrants shall be located in every required fire-isolated exit, other than where coverage is provided in accordance with Clause 3.5.1, regardless of the number of fire hydrants needed to provide coverage.

Clause 3.6.2(b) of AS 2419.1-2021 states that where required non-fire-isolated exits are provided, internal fire hydrants shall be located not more than 4 m from a required exit, except that internal fire hydrants need not be located adjacent to each required non-fire-isolated exit, provided fire hydrant coverage to all parts of the floor is achieved.

Provisions of AS 2419.1-2021 notwithstanding, DFES requests that performance-based fire hose coverage is measured based on the provisions of AS 2419.1-2005, i.e. each hose length used shall be 30 m, and 10 m hose stream with at least 1 m of hose extended into the last protected room is considered. This requirement is reflected in the DFES Built Environment Branch (BEB) Info Note: *“Variations to AS 2419.1:2021 fire hydrant installations based on the FES Commissioner’s Operational Requirements”*.

### 18.2 Performance Solution

Fire hose coverage to the GSC is provided from external and internal attack fire hydrants. External fire hydrants are located outside the footprint of the building and internal fire hydrants are located in the retail malls, the existing open-deck carpark on the north-west side of the centre and in the new Loading Dock 04 (refer to the fire hose coverage diagrams in Appendix D).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed not more than 50 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 70 m, which does not comply with the provisions of Clause 3.5.3.3(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from external attack fire hydrants installed on a podium not more than 100 m from a fire brigade pumping appliance, i.e. 90 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.5.3.3(c) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Fire hose coverage is achieved with the use of an additional length of hose from internal attack fire hydrants installed in retail malls, i.e. 60 m of hose is used in lieu of 40 m, which does not comply with the provisions of Clause 3.6.1(e) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants are not located in every fire-isolated exit, which does not comply with the provisions of Clause 3.6.2(a)(ii) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

Internal fire hydrants installed in retail malls are provided more than 4 m from required exits, which does not comply with the provisions of Clause 3.6.2(b) of AS 2419.1-2021 and the DtS provisions of BCA Clause E1D2(2).

### 18.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P3.

### 18.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.

### 18.5 Intent of the BCA

The intent of Performance Requirement E1P3 (formerly EP1.3) is to install a fire hydrant system that is capable of providing *“adequate water, under sufficient pressure and flow, to allow the fire brigade to fight fires”*.

The Guide to the BCA highlights that fire hydrant systems “*are intended for use only by a fire brigade*” and stresses that compliance with the DtS provisions of Clause E1D2 (formerly E1.3) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P3 is satisfied.

It is reasonable to assume that an extra length of hose from internal and external fire hydrants required to achieve complete fire hose coverage and/or the performance-based locations of fire hydrants may have an adverse impact on fire brigade intervention.

It is therefore necessary to consult with the local fire brigade to determine whether a performance-based fire hydrant system facilitates their intervention. DFES are the main authority in Western Australia that can provide expert advice in regard to fire brigade intervention requirements.

### 18.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based fire hose coverage with 2 lengths of hose from internal fire hydrants, 3 lengths of hose from external fire hydrants and hydrants installed on the podium, fire hydrants not provided in every fire-isolated exits and internal fire hydrants located more than 4 m from non-fire-isolated exits do not have an adverse impact on DFES intervention.

If DFES confirm that the performance-based aspects of the fire hydrant system facilitate their intervention, then compliance with Performance Requirement E1P3 is achieved.

The methodology adopted for this assessment is an absolute, qualitative deterministic analysis in accordance with the following:

1. Identify configuration of the fire hydrant system and locations of the onsite attack fire hydrants.
2. Assess the performance-based locations of fire hydrants installed more than 4 m from non-fire-isolated exits and the potential impact these locations may have on firefighting operations.
3. Assess the ability of the fire brigade to identify where additional hose may be required to achieve coverage and the impact on fire brigade operations.
4. Review the water supply capacity and the performance of the fire hydrant system to ascertain the required demand is available.
5. Consult with DFES in regard to the proposed fire safety strategy and determine whether their intervention is facilitated.

### 18.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *External attack fire hydrants at street level shall be located not more than 50 m from a DFES pumping appliance parked on a hardstand.*
2. *External attack fire hydrants located on the podium (the roof of the north-east open-deck carpark) shall be located not more than 100 m from a DFES pumping appliance parked on a hardstand.*

3. *Internal attack fire hydrants shall be located not more than 25 m from exits.*
4. *Where additional internal attack fire hydrants are required in the retail mall, they shall be located not more than 25 m from the hydrants that are located within 25 m from exits.*
5. *Extended fire hose coverage to the building must facilitate DFES intervention, i.e.:*
  - c. *All parts of the building shall be not more than 90 m from external attack fire hydrants; and*
  - d. *Where parts of the building cannot be reached with hose connected to external attack fire hydrants, these parts shall be not more than 60 m from internal attack fire hydrant installed in the retail malls.*
  - e. *The length of fire hose laid inside the building must not exceed 60 m.*
  - f. *At least 1 m of hose must extend into the furthestmost protected room.*
6. *The flow and pressure at the discharge outlets of the attack fire hydrants shall comply with the requirements of AS 2419.1-2021, i.e. 15 l/sec flow @ 700 kPa pressure without the use of a fire brigade pumping appliance and 30 l/s flow @ 700 kPa pressure when boosted by a fire brigade pumping appliance.*
7. *Signage must be provided to enable DFES identify the areas that require additional length of fire hose to achieve complete coverage.*

## 19. Performance Solution No. 9 – Performance-based Attack on Fire by Building Occupants

### 19.1 Relevant BCA DtS Provisions

BCA Clause E1D3(2)(a) states that a fire hose reel system must be provided to serve the whole building where one or more fire hydrants are installed.

### 19.2 Performance Solution

Fire hose coverage to the GSC is provided both from internal and external attack fire hydrants; hence fire hose reels are prescribed.

Fire hose reels in the refurbished and extended parts of the GSC (areas highlighted pink and cyan in Figure 62 and Figure 63 below) are not provided and the initial attack on a fire by occupants is facilitated with the use of portable fire extinguishers, which does not comply with the DtS provisions of Clause E1D3(2)(a).

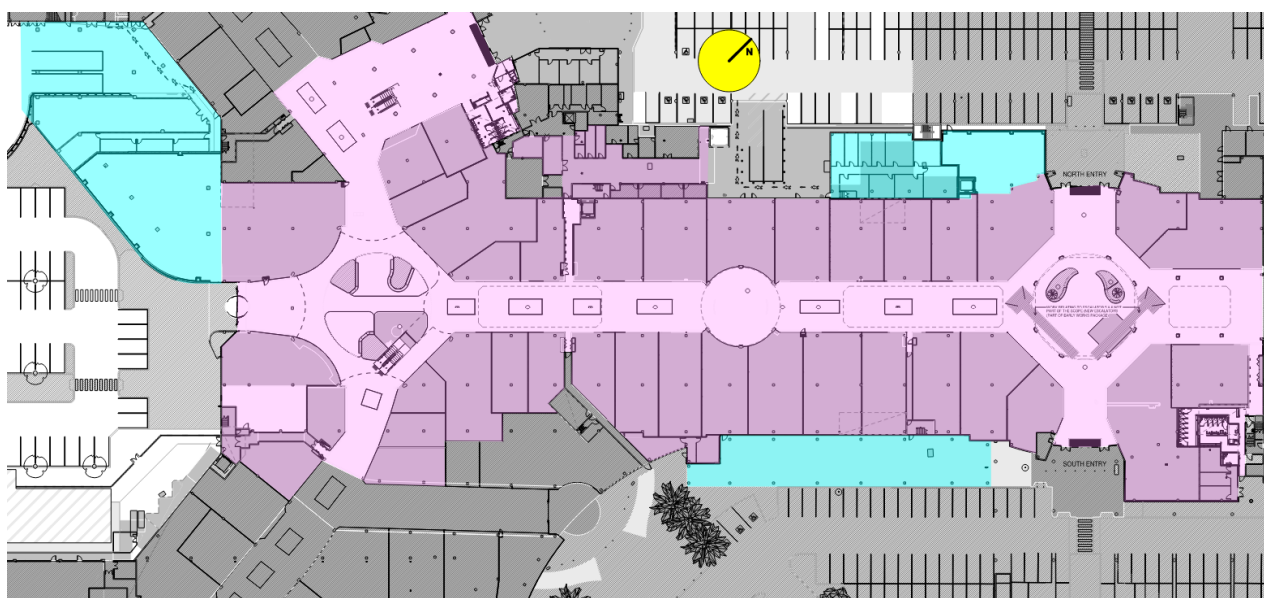


Figure 62: Areas where fire hose reels are omitted on Ground Floor

### 19.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P1.

### 19.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.



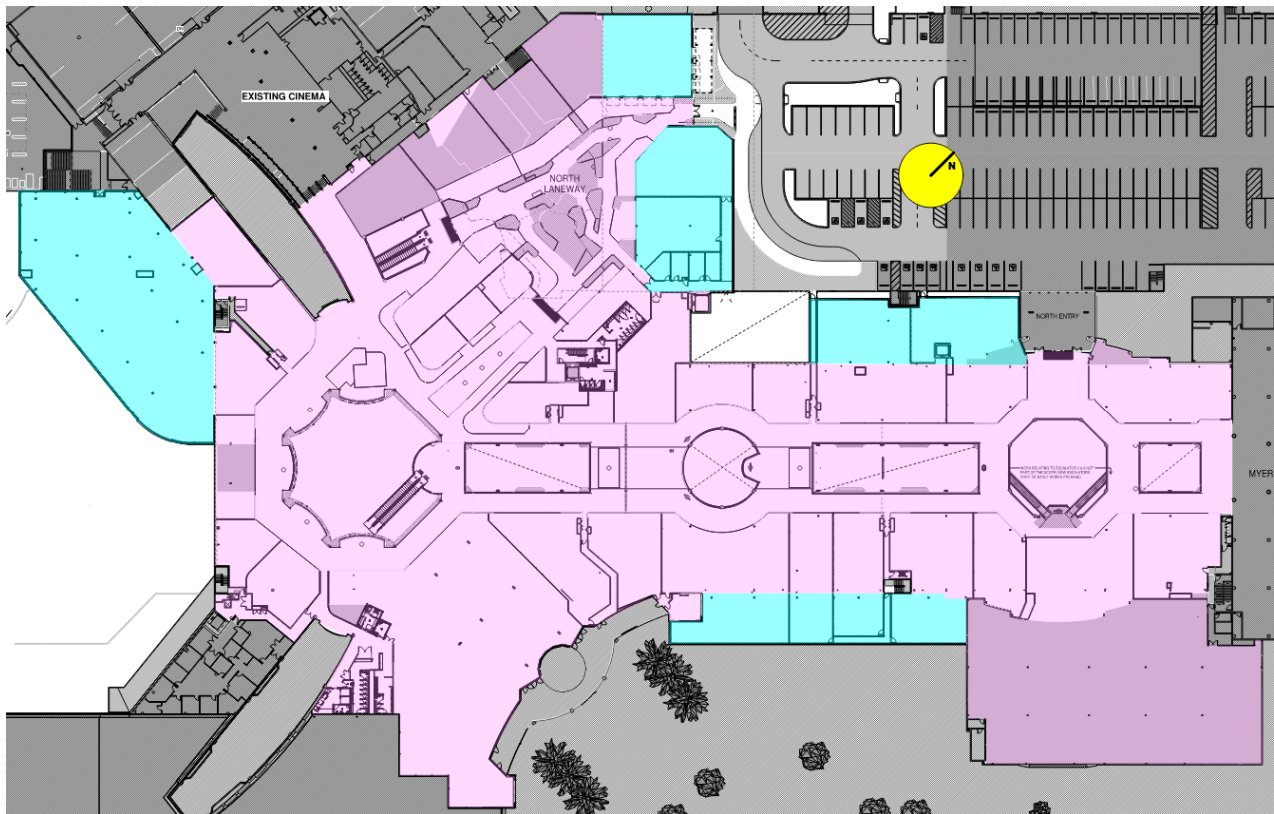


Figure 63: Areas where fire hose reels are omitted on First Floor

### 19.5 Intent of the BCA

The intent of Performance Requirement E1P1 (formerly EP1.1) is to allow occupants to fight fire in the initial stages of its development, which “*may reduce the hazard, allow more time for evacuation and prevent structural damage*”. The Guide to the BCA also indicates that fire hose reels “*must be installed when necessary, and be appropriate to a number of factors, including:*

- *the size of the fire compartment which is a measure of the size of any potential fire;*
- *the function of the building will affect the fire load in the building;*
- *the fire-safety systems which can affect the rate of fire spread (e.g. if a sprinkler system is installed in a building, it should extinguish the fire or reduce its growth rate); and*
- *the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire”.*

The Guide to the BCA stresses that compliance with BCA Clause E1D3 (formerly E1.4) is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement E1P1 is satisfied.

It is evident that fire hose reels are provided for occupants to commence the initial attack on a fire. The above notwithstanding, the design must adequately address occupant safety. It is therefore reasonable to conclude that if deployment of a fire hose reel could potentially compromise occupant safety, alternative means of initial attack on a fire may be more appropriate.

### 19.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of fire hose reels will not have an adverse impact on the ability of occupants to fight fire in the initial stages of its development.

If it can be demonstrated that provision of portable fire extinguishers in lieu of fire hose reels facilitates the initial occupant attack on a fire, then compliance with Performance Requirement E1P1 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative deterministic analysis in accordance with the following:

1. Develop a fire safety strategy to facilitate occupants' initial attack on a fire and assess the following aspects of the provision of portable fire extinguishers:
  - a. Class of fire risk that portable fire extinguishers are suitable for, and the typical fire risks expected to be present in the building, including forklifts.
  - b. Usability of portable fire extinguishers with regard to approaching the fire.
  - c. The risk of users of portable fire extinguishers impeding their own egress or the egress of others.

### 19.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *Occupants shall be provided with adequate fire safety measures that would facilitate their initial attack on a fire.*

## 20. Performance Solution No. 10 – Omission of Sprinklers from Skylights and External Covered Area

### 20.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C2(a) of BCA Specification S17 states that an automatic sprinkler system must comply with AS 2118.1-2017.

Clause 3.1.2 of AS 2118.1-2017 states that for a building to be classified as a sprinkler protected building, the building shall be sprinkler protected throughout, other than where exceptions are permitted in Clause 3.1.3. Clause 3.1.3 does not provide an exemption for omission of sprinklers under skylights.

### 20.2 Performance Solution

Sprinklers are omitted from the skylights above the Myer retail mall and Plaza and from the soffit of the new First Floor extension along the south-east façade adjacent to the sprinkler-protected carpark below the Rebel tenancy (areas highlighted red in Figure 64 and Figure 65, respectively), which does not comply with the DtS provisions of Clause 3.1.2 of AS 2118.1-2017 and the DtS provisions of Clause S17C2(a) of BCA Specification S17 and Clause E1D4(b).

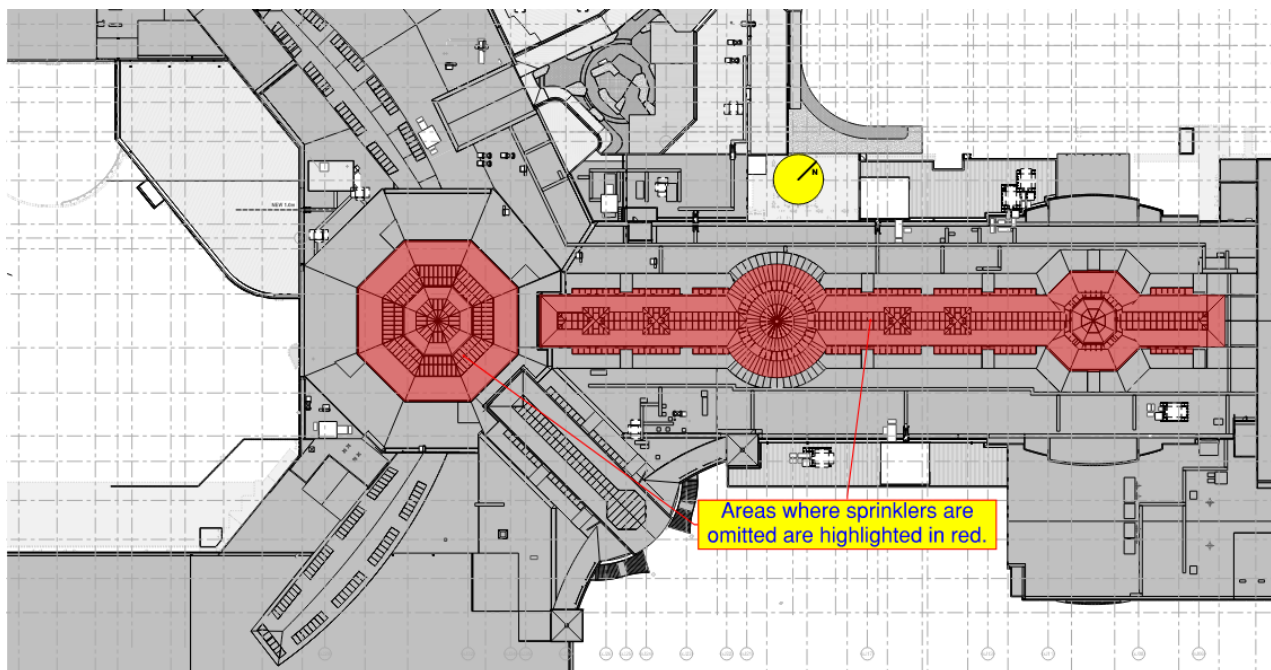


Figure 64: Omission of sprinkler from Plaza and Myer mall skylights

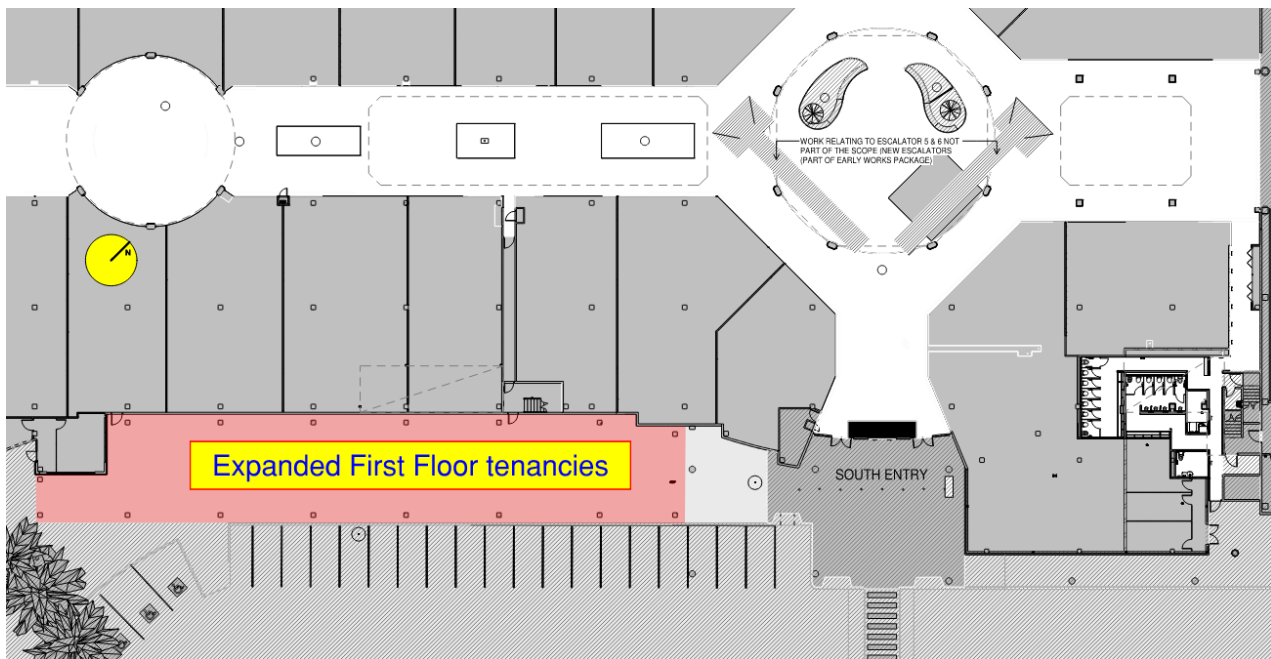


Figure 65: Omission of sprinkler below new extended tenancies on First Floor

### 20.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as E1P4 and E2P2.

### 20.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.

### 20.5 Intent of the BCA

The intent of Performance Requirement E1P4 (formerly EP1.4) is “life safety and fire suppression”.

Performance Requirement E1P4 uses the term *“to the degree necessary”*. The Guide to the BCA states that the use of this term means that the *“BCA recognises that not all buildings need an automatic fire suppression system”*.

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient *“time to evacuate before the onset of untenable conditions”*. The Guide to the BCA identifies the untenable conditions as: *“dangerous temperatures, low visibility and dangerous levels of toxicity”*.

It is evident that parts of a building that present a very low fire risk or where the height of the roof above the fire seat would result in significant delay in sprinkler activation may not need sprinkler protection to satisfy Performance Requirements E1P4 and E2P2, as long as adequate fire safety measures are provided to warn occupants of a potential fire and facilitate their evacuation; to minimise the risk of fire spread throughout the building; and to facilitate fire brigade intervention.

## 20.6 Assessment Methodology

The purpose of this assessment is to demonstrate that omission of sprinkler protection from selected areas in an otherwise sprinkler protected building would not result in a fire that could spread uncontrolled through the rest of the building.

If it can be demonstrated that a fire originating in an area that is not provided with sprinkler protection will not spread to adjacent areas and occupant evacuation during a fire that is not sprinkler controlled is facilitated, then compliance with Performance Requirement E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative and quantitative deterministic analysis in accordance with the following:

1. Determine the type of sprinkler system provided in the retail mall and identify areas where sprinkler protection is not provided.
2. Identify worst-case fire scenarios that could occur in the retail mall where sprinkler protection is not provided, i.e. fires involving kiosks or displays, including vehicle displays.
3. Undertake fire and smoke modelling for the worst-case fire scenarios in the retail malls using the computer program Fire Dynamics Simulator (FDS) and determine the ASET. Refer to Section 10.3 for the modelling parameters and Section 10.4 for details of adopted limiting criteria (refer to Performance Solution No. 5).
4. Undertake egress modelling using the computer program Pathfinder and determine the RSET. Refer to Section 10.2.3 for the egress modelling parameters (refer to Performance Solution No. 5).
5. Compare the derived ASET and RSET to determine if the design is acceptable.
6. Identify the expected fire load in the area below the First Floor tenancies expansion along the south-east façade.
7. Determine whether a fire that has a potential to spread to the rest of the building could start in this area.
8. Develop a fire safety strategy that would enhance the fire safety measures in the areas where sprinklers are not provided (if required).

## 20.7 Acceptance Criteria

The acceptance criteria for this assessment are:

1. *Where sprinklers are omitted from the retail mall skylights, the ASET calculated for the sensitivity fire scenarios must be equal to or greater than the RSET for those fire scenarios:*

$$ASET \geq RSET$$

2. *Where sprinklers are omitted from the retail mall skylights, routine conditions for fire fighters must be maintained up until fire brigade apply water to the fire for the design fire scenarios.*



3. *Where sprinklers are omitted from the soffit below the First Floor tenancies extension, the area shall be kept free of combustibles and used as circulation space only.*

## 21. Performance Solution No. 11 – Performance-based Fire Sprinkler System in North Laneway

### 21.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17.

Clause S17C2(a) of BCA Specification 17 states that an automatic fire sprinkler system must comply with AS 2118.1-2017.

Clause 3.1.1.2 of AS 2118.1-2017 states that *“to be classified as a sprinkler-protected building, a building shall be sprinkler-protected throughout, other than where exceptions are permitted in Class 3.1.3 (see Clause 5.6.10)”*.

Clause 3.1.3 of AS 2118.1-2017 does not provide cover canopies, which are addressed in Clause 5.6.10.

Clause 5.6.10 of AS 2118.1-2017 states that *“sprinklers shall be installed under all canopies where goods are stored or handled or where the dividing wall between the canopy and the building has an FRL less than --/30/30. Notwithstanding the requirements of Clauses 3.1.1.2 and 3.1.1.3, in the case of canopies of non-combustible construction less than 2.5 m in width over pedestrian walkways, sprinklers may be omitted”*.

Clause 5.5.3 of AS 2118.1-2017 in parts states that *“the distance between rows of sprinklers shall comply with the following requirements:*

- (a) “Rooms not exceeding 3.7 m in width shall have a minimum of one row of sprinklers along the length of the room.*
- (b) “Rooms exceeding 3.7 m but not exceeding 7.4 m in width shall have one row of sprinklers at each side along the length of the room.*
- (c) “In rooms exceeding 7.4 m in width, conventional, spray or ceiling type sprinklers shall be provided centrally positioned under the ceiling to supplement the sidewall sprinklers”*.

### 21.2 Performance Solution

The North Laneway, located on the northwest side of Level 1 adjacent to the cinema entrance, forms part of the new Food & Beverage (F&B) precinct. It is situated outside the main shopping mall, with F&B tenancies positioned along both the east and west sides (spaces highlighted purple in Figure 66 below), and a central seating area located between them.

Canopies are provided around the full perimeter of the North Laneway. They protect both external seating areas of the tenancies (areas identified with blue square hatching in Figure 66 below) and parts of the circulation space outside the tenancies' lease areas.

The canopies on the western side of the Laneway (canopies highlighted dark green in Figure 66 below) are protected with conventional sprinklers, and full compliance with the provisions of AS 2118.1 is achieved.

The canopies on the eastern side of the Laneway are up to 9.0 m wide; however, they are protected with a single row of vertical sidewall sprinklers that are installed against the external walls of the adjacent tenancies. Based on the provisions of Clause 5.5.3(a) of AS 2118.1, it is reasonable to conclude that a single row of sprinklers can protect only up to 3.7 m of the canopy when measured from the location of the sprinkler.

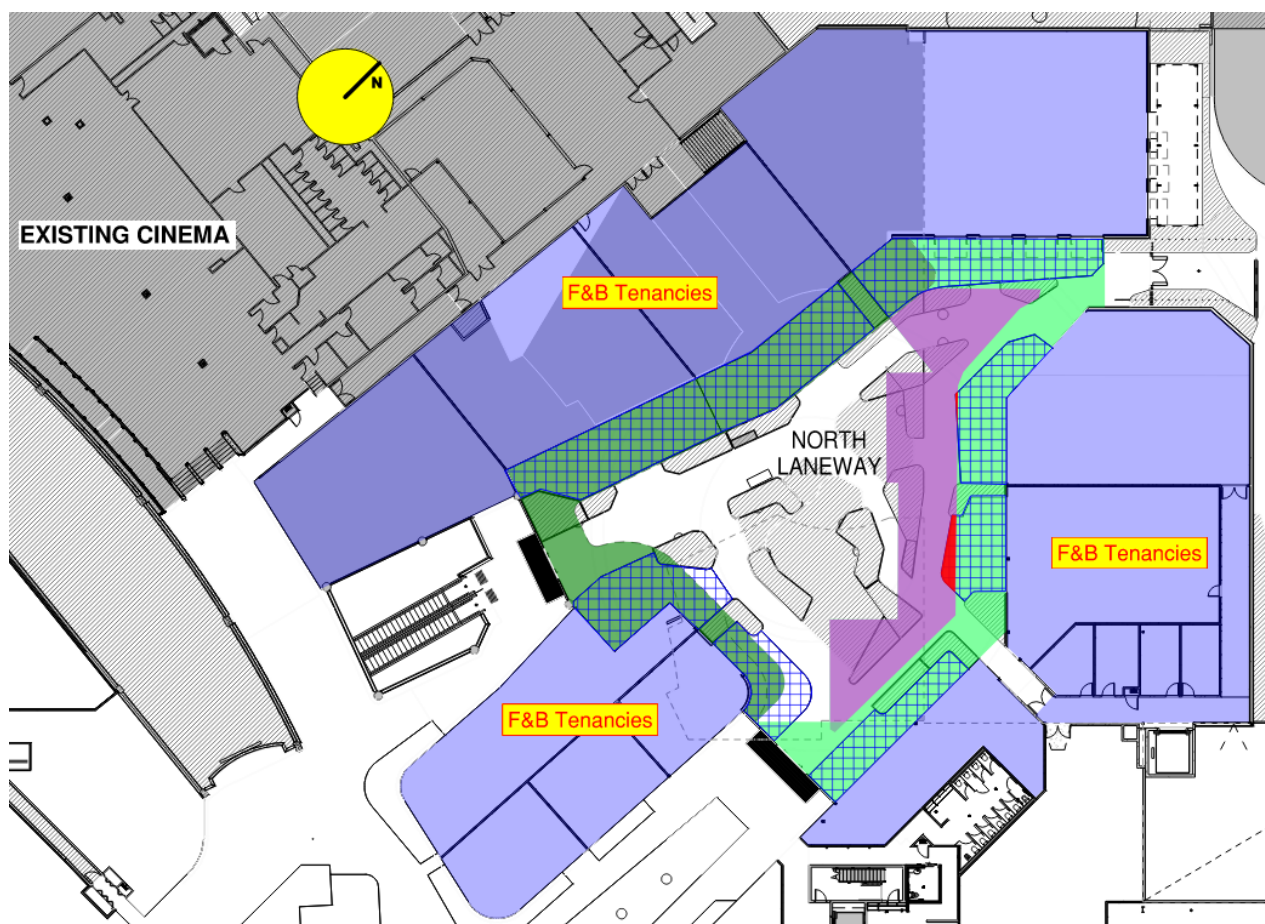


Figure 66: North Laneway layout and extent of sprinkler protection to canopies

Parts of the eastern canopies that are considered to be provided with compliant sprinkler protection in accordance with Clause 5.5.3(a) of AS 2118.1 are highlighted light green in Figure 66 and parts of the canopies that are not protected are highlighted dark pink.

While the 'unprotected' canopies are generally located above circulation space, there are 2 areas where the full extent of the tenancy seating is not protected (areas highlighted red in Figure 66 below). Therefore, the eastern canopies are provided with performance-based sprinkler protection that does not comply in full with the provisions of Clauses 3.1.3, 5.5.3(c) and 5.6.10 of AS 2118.1-2017 and the DtS provisions of BCA Clause E1D4(b) and Clause S17C2(a) of BCA Specification 17.

### 21.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E1P4.

### 21.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. "other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements".

### 21.5 Intent of the BCA

The intent of Performance Requirement E1P4 (formerly EP1.4) is “*life safety and fire suppression*”.

Performance Requirements E1P4 states “*An automatic fire suppression system must be installed to the degree necessary to control the development and spread of fire appropriate to:*

- a. the size of the fire compartment; and*
- b. the function or use of the building; and*
- c. the fire hazard; and*
- d. the height of the building.”*

It is evident that if the risk of a significant fire developing in parts of the building is limited, extending sprinkler protection that complies in full with the provisions of AS 2118.1 to these parts may not be necessary to achieve compliance with Performance Requirement E1P4.

### 21.6 Assessment Methodology

The purpose of this assessment is to demonstrate that performance-based fire sprinkler protection to parts of the eastern canopies that are located more than 3.7 m from the sprinklers would not result in a fire that could spread uncontrolled through the rest of the building.

If it can be demonstrate that the performance-based fire sprinkler system is adequate for the hazard protected, i.e. sprinklers are capable of providing protection to all parts where fire load is present, then compliance with Performance Requirements E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, qualitative, deterministic analysis in accordance with the following:

1. Establish the location where the performance-based sprinkler system is provided.
2. Identify areas under the canopies where fire load is present and where a fire could occur.
3. Assess the performance of vertical sidewall sprinklers and the area that they can protect (based on spray patterns provided in the sprinkler datasheets).
4. Determine whether the performance-based sprinkler system is capable of providing an adequate level of protection to the areas under the eastern canopies.
5. If the performance-based sprinkler system is capable of protecting the hazard concerned, then compliance with Performance Requirement E1P4 is achieved.

### 21.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The performance-based sprinkler system under the eastern canopies of the North Laneway shall be capable of controlling a potential fire under the canopy.*

## 22. Performance Solution No. 12 – Performance-based Separation between Sprinklered and Non-sprinklered Parts

### 22.1 Relevant BCA DtS Provisions

BCA Clause E1D4(b) states that a sprinkler system must comply with Specification 17 and Specification 18 as applicable.

Clause S17C3(a) of BCA Specification 17 states that where a part of a building is not protected with sprinklers, the sprinklered and non-sprinklered parts must be fire-separated with a wall or floor which must comply with any specific requirements of DtS provisions of the BCA.

BCA Clause C3D9(1)(b) states that if a building has parts of different classifications located alongside one another in the same storey, the parts must be separated in that storey by a fire wall if each building element in that storey does not have the higher FRL prescribed by Specification 5.

Clause S5C22(3)(c)(i) of BCA Specification 5 states that fire walls between the carpark and the rest of the building shall achieve a minimum FRL 60/60/60 from the direction used as a carpark.

Glazed openings in fire walls are not covered by BCA Part C4, and therefore shall be considered a performance-based design. The benchmark FRL for a glazed opening in a fire wall that achieves FRL 60/60/60, considering that glazed openings are non-load-bearing, should be --/60/60.

### 22.2 Performance Solution

The existing north-west open-deck carpark that is not provided with sprinkler protection abuts parts of the centre that have glazed sections in the bounding walls. These glazed sections are located at the north and north-west entrances to the retail mall and along the façade of the external tenancy adjacent to the north-west entrance to the mall (the glazed sections of the walls are clouded red in Figure 67).

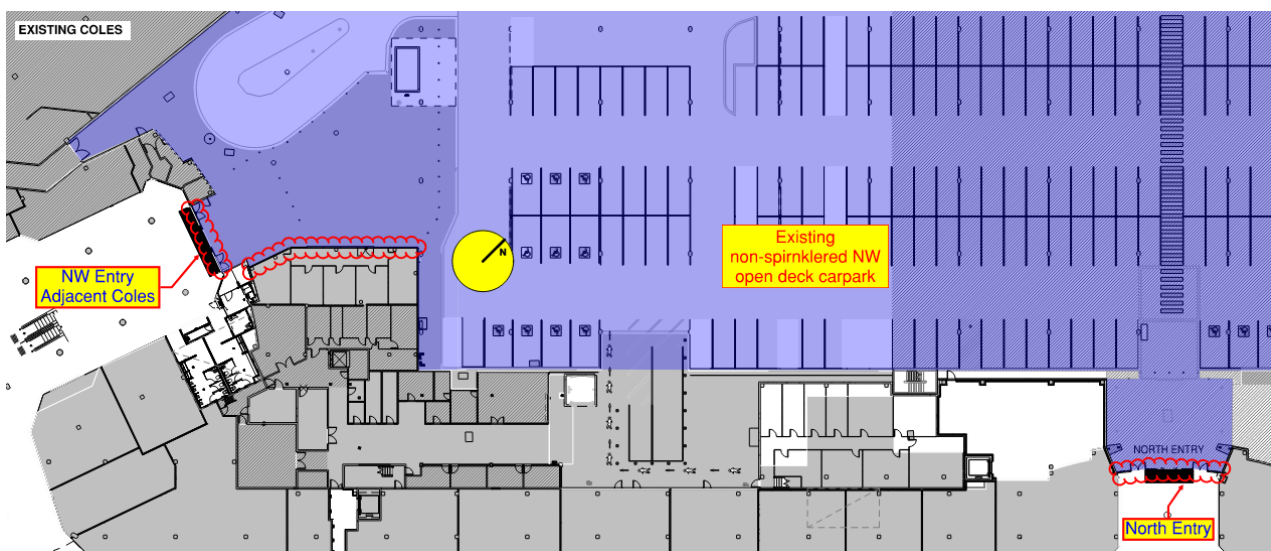


Figure 67: Locations where the walls between the sprinkler protected retail parts of the centre and the open-deck carpark that is not sprinkler protected have glazed sections



The glazed sections of the walls that are exposed to the open-deck carpark that is not sprinkler protected will not be protected and will not achieve FRL --/60/60, which does not comply with the DtS provisions of Clause S17C3(a) of BCA Specification 17 and Clause E1D4(b).\

### 22.3 Relevant Performance Requirements

The relevant Performance Requirements have been identified as C1P2(1)(d) and E1P4.

### 22.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.

### 22.5 Intent of the BCA

The intent of Performance Requirement C1P2(1)(d) (formerly CP2(a)(iv)) is to minimise the risk of fire spreading through a building that could endanger the occupants and impede the actions of the fire brigade.

The Guide to the BCA states that *“the BCA recognises that different building elements require differing degrees of protection to avoid the spread of fire”*. The Guide also highlights that compliance with the DtS provisions in regards to fire separation *“is not compulsory if alternative means can be found to satisfy the appropriate authority that the Performance Requirements will be achieved”*. This provision is intended *“to allow the appropriate authority to determine the degree of compliance necessary in each particular case after considering each building scenario”*.

The intent of Performance Requirement E1P4 is *“life safety and fire suppression”*.

Performance Requirement E1P4 uses the term *“to the degree necessary”*. The Guide to the BCA states that the use of this term means that the *“BCA recognises that not all buildings need an automatic fire suppression system”*.

It is evident that if adequate separation is not provided between parts of the building that are not protected with sprinklers and the sprinkler-protected parts, a fire in the non-sprinklered part may overwhelm the sprinkler system in the protected part, which may lead to fire spread through the building.

### 22.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the performance-based separation between sprinklered and non-sprinklered parts would not increase the risk of fire spread through the building.

If it can be demonstrated that a fire starting in the non-sprinklered part of the building will not spread to the sprinklered part via the unprotected glazed openings, then compliance with Performance Requirements C1P2(1)(d) and E1P4 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute, quantitative and qualitative deterministic analysis in accordance with the following:

1. Identify the type of construction between sprinklered and non-sprinklered parts.

2. Establish fire scenarios in the non-sprinklered open-deck carpark that may have the worst impact on the glazed openings.
3. Identify the location of fire in each fire scenario relative to the exposed openings.
4. Determine the configuration of the radiant heat sources that may radiate heat toward the glazed openings.
5. Identify target points at the glazed openings that are likely to be exposed to the highest radiant heat flux during a fire in the open-deck carpark.
6. Calculate the radiant heat flux at the target points using module Radiation from the FireWind 3.6 suite of fire safety engineering software [FMC, 2013].

## 22.7 Acceptance Criteria

There is a lot of information about critical heat fluxes for different combustible materials, i.e. heat fluxes at which combustible materials are expected to ignite under piloted and non-piloted conditions.

The Australian Building Codes Board suggests the following heat flux intensity that can cause piloted and non-piloted ignition of timber and curtain materials [ABCB, 2020a]:

| Material         | Piloted Ignition     | Non-piloted Ignition |
|------------------|----------------------|----------------------|
| Timber           | 20 kW/m <sup>2</sup> | 35 kW/m <sup>2</sup> |
| Curtain material | 10 kW/m <sup>2</sup> | 20 kW/m <sup>2</sup> |

*Table 27: Heat flux required to cause piloted and non-piloted ignition of some materials*

The above values form part of the BCA Verification Method C1V1 [ABCB, 2022a]. In accordance with C1V1 a wall located 3 m of the side or rear boundary of an allotment needs to withstand a radiant heat flux of 20 kW/m<sup>2</sup>. BCA Clause C4D3(2)(a) states that only those openings that are less than 3 m from the fire-source feature shall be protected. It is therefore reasonable to conclude that an opening located 3 m from the side or rear boundary of the allotment and exposed to a radiant heat flux of 20 kW/m<sup>2</sup> without protection achieves compliance with the BCA Performance Requirements.

AS 1530.4-2014 “Methods for fire tests on building materials, components and structures; Part 4: Fire-resistance tests for elements of construction” [SA, 2014] suggests different values for critical radiant heat flux (refer to Table 28 below).

**TABLE A3**  
**TYPICAL RADIANT HEAT INTENSITIES**  
**FOR VARIOUS PHENOMENA**

| Phenomena                                                    | kW/m <sup>2</sup> |
|--------------------------------------------------------------|-------------------|
| <b>Maximum for indefinite exposure for humans</b>            |                   |
| Pain after 10 s to 20 s                                      | 4                 |
| Pain after 3 s                                               | 10                |
| Piloted ignition of cotton fabric after a long time          | 13                |
| Piloted ignition of timber after a long time                 | 13                |
| Non-piloted ignition of cotton fabric after a long time      | 25                |
| Non-piloted ignition of timber after a long time             | 25                |
| Non-piloted ignition of gabardine fabric after a long time   | 27                |
| Non-piloted ignition of black drill fabric after a long time | 38                |
| Non-piloted ignition of cotton fabric after 5 s              | 42                |
| Non-piloted ignition of timber in 20 s                       | 45                |
| Non-piloted ignition of timber in 10 s                       | 55                |

*Table 28: Typical radiant heat intensities for various phenomena, as per AS 1530.4-2014*

The values provided by the BCA are more conservative than those provided by the Australian Standard. Still it is evident that radiant heat from a fire should not cause non-piloted ignition if the heat flux does not exceed 20 kW/m<sup>2</sup>, or piloted ignition if the heat flux is 10 kW/m<sup>2</sup> or less.

Before a fire can spread from one area to the other, the exposed combustible materials must be heated to a temperature at which piloted or non-piloted ignition can occur. Piloted ignition occurs when a combustible material is directly exposed to a pilot flame generally in the presence of a heat source. Considering that all glazed openings have doors in them, it is conservatively assumed that during a worst-case fire scenario piloted ignition of lightweight furnishings adjacent to these doors may occur.

Therefore, the acceptance criterion for this assessment is:

1. *Radiant heat flux at the closest edge of the exposed glazed openings must not exceed the critical limit for piloted ignition of light-weight furnishings, i.e. 10 kW/m<sup>2</sup>.*

## 22.8 Radiant Heat Flux Assessment Input Parameters

### 22.8.1 Fire Scenario Selection

An essential aspect of a fire safety engineering assessment is the identification of appropriate fire scenarios.

The most likely and highest risk fire scenario for the north-west entrance adjacent to Coles involves a fire occurring in a vehicle parked in the Click and Collect drive-through area. In this scenario, the vehicle is positioned closest to the glazed entry. This scenario is illustrated in Figure 68 below and is identified as Fire Scenario 1 (FS-01). As shown in Figure 68, the vehicle is located approximately 12 m from the glazed entry. Such fire could also adversely impact the shopfront glazing of the adjacent tenancy, which is approximately 13.6 m from the vehicle.

Another potential scenario that could affect the shopfront glazing is a fire occurring in a vehicle parked in the driveway of the open-deck carpark. This scenario is illustrated in Figure 68 below and is identified as Fire Scenario 2 (FS-02). As shown in Figure 68, the vehicle is located approximately 7.6 m from the glazed entry.

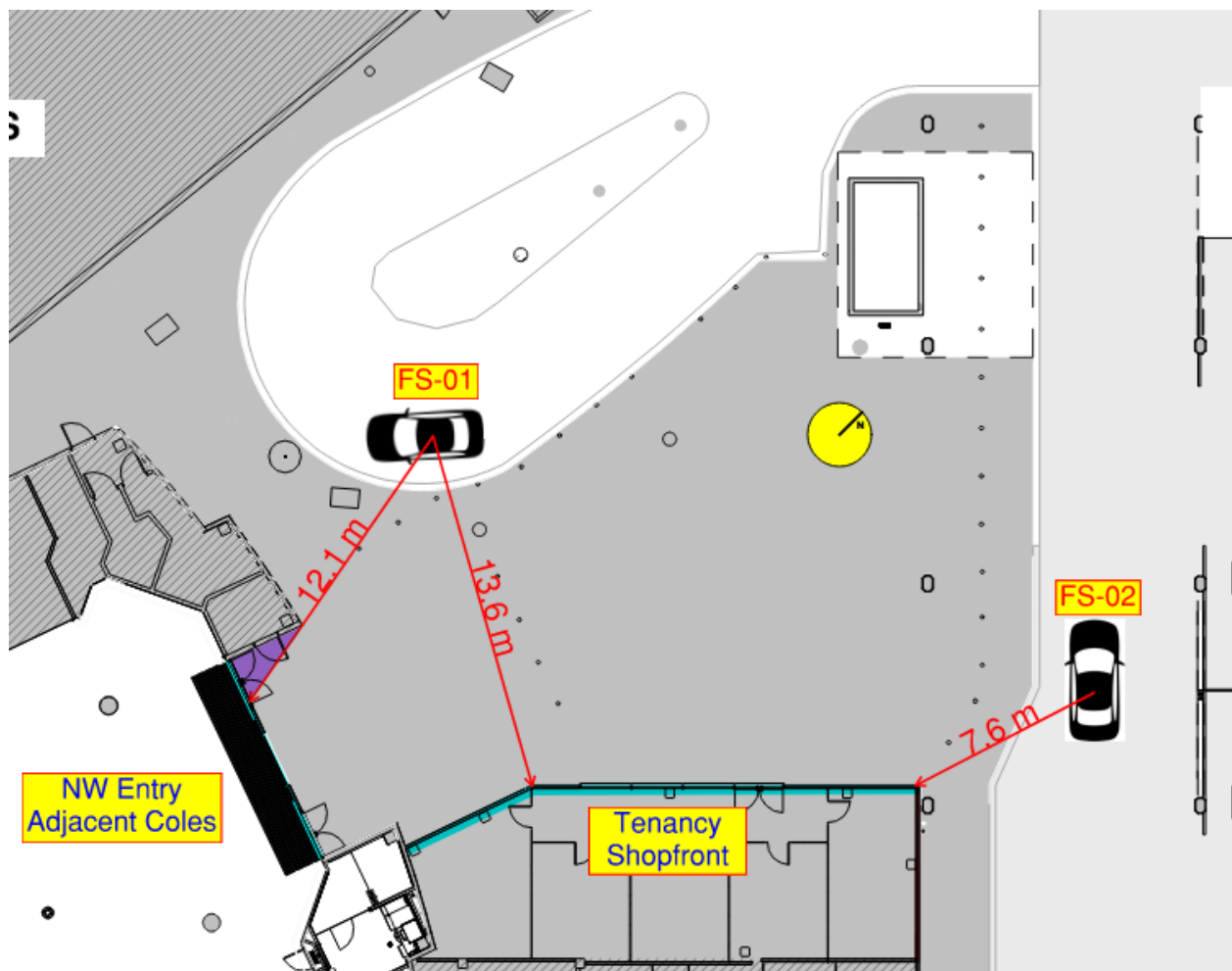


Figure 68: Fire scenarios for the north-west entrance adjacent Coles to the adjacent tenancy

The most likely and highest risk fire scenario for the north entrance involves a fire occurring in a vehicle parked in the bay closest to the north entrance. This scenario is shown in Figure 69 and is identified as Fire Scenario 3 (FS-03).

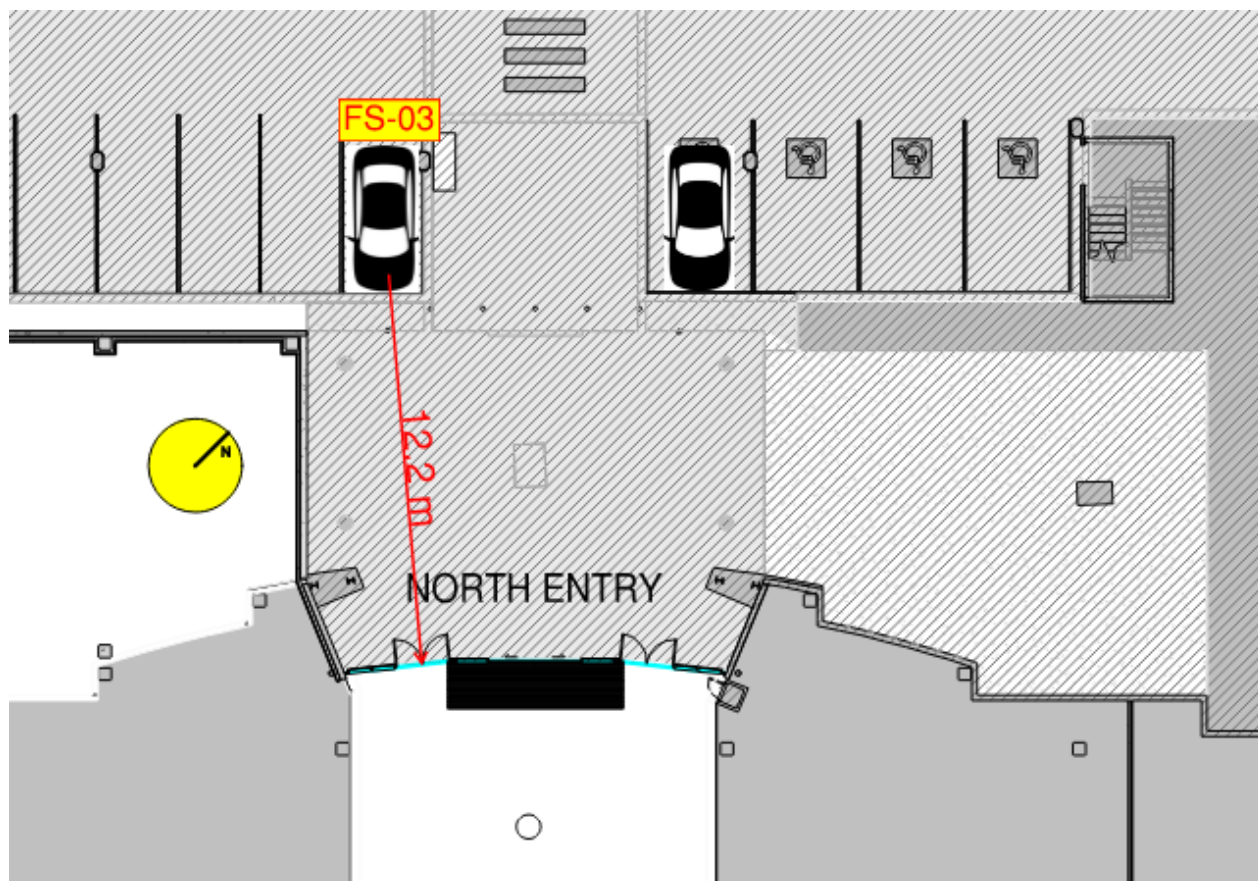


Figure 69: Fire scenario for the north entrance



## 23. Performance Solution No. 13 – Performance-based Increased Air Velocity through Make-up Air Openings

### 23.1 Relevant BCA DtS Provisions

BCA Clause E2D15(2)(a) states that *“where the floor area of a Class 6 part of a fire compartment ... is more than 2,000 m<sup>2</sup>, the fire compartment, including the enclosed common walkway or mall, must be provided with— an automatic smoke exhaust system complying with Specification 21”*.

Clause S21C6(2) of BCA Specification 21 states *“the velocity of make-up air through doorways must not exceed 2.5 m/s”*.

### 23.2 Performance Solution

Make-up air is provided for the smoke exhaust systems in the Timezone and JB Hi-Fi tenancies from the retail mall via the shopfronts. The smoke exhaust rates in both tenancies and the make-up air provisions during trading hours are BCA DtS compliant for both tenancies.

After-hours however the net free open area of the openings does not allow to achieve make-up air velocity of less than 2.5 m/s. The size of the make-up air openings is currently not available and will be confirmed at the FSER stage of the project; however, the make-up air velocity through these openings is not expected to exceed 3.5 m/s, which does not comply with the DtS provisions of Clause S21C6(2) of BCA Specification 21 and Clause E2D15(2)(a).

### 23.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E2P2.

### 23.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. *“other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements”*.

### 23.5 Intent of the BCA

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient *“time to evacuate before the onset of untenable conditions”*. The Guide to the BCA identifies the untenable conditions as: *“dangerous temperatures, low visibility and dangerous levels of toxicity”*.

The intent of Clause S21C6 of Specification 21 (formerly Clause 6 of Specification E2.2b) is *“to provide air to replace that being exhausted by the smoke exhaust system”*.

The Guide to the BCA states that the intent of Clause S21C6(2) (formerly Clause 6(b) of Specification E2.2b) is to ensure that make-up air introduced below the smoke layer is at relatively low velocities, to minimise any disturbance to the smoke layer. The Guide further clarifies that *“make-up air introduced at higher velocities may cause:*

- *“smoke to be drawn down from the hot layer, called the “venturi effect”, leading to a loss of visibility in the space below; and*
- *“difficulties for people attempting to exit against the in-rush of air through doorways”*.

It is evident that the intent of the BCA is to ensure that the make-up air velocity is low enough to prevent significant disturbance to the smoke layer that could compromise safe occupant evacuation.

### **23.6 Assessment Methodology**

The purpose of this assessment is to demonstrate that after-hours the increased make-up air velocity through the Timezone and JB Hi-Fi shopfront openings does not have an adverse impact on safe occupant evacuation and fire brigade intervention.

It is considered that if it can be demonstrated that the increased make-up air velocity through the roller-shutters does not disturb the smoke layer to a degree that could impede safe occupant evacuation and fire brigade intervention, compliance with Performance Requirement E2P2 is achieved.

The methodology adopted for the assessment is an absolute, quantitative deterministic analysis in accordance with the following:

1. Determine the after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings.
2. Carry out Computational Fire Dynamics (CFD) modelling using computer program FDS-6 [McGrattan, 2023] and determine air velocities on the Timezone and JB Hi-Fi side of the shopfronts.
3. Determine whether increased make-up air velocities through the shopfront openings has an adverse impact on the smoke layer.

### **23.7 Acceptance Criteria**

The acceptance criterion for this assessment is:

1. *The increased after-hours make-up air velocity through the Timezone and JB Hi-Fi shopfront openings must not disturb the smoke layer in the tenancy to a point where it could compromise safe occupant evacuation and fire brigade intervention.*

## 24. Performance Solution No. 14 – Performance-based Increased Noise Levels of Existing Smoke Exhaust Fans

### 24.1 Relevant BCA DtS Provisions

Clause E2D15(2)(a) states that a building “*containing an enclosed common walkway or mall serving more than one Class 6 sole-occupancy unit*” in a fire compartment with a floor area greater than 2,000 m<sup>2</sup> must be provided with “*an automatic smoke exhaust system complying with Specification 21*”.

The BCA DtS provisions do not directly reference AS 1668.1-2015 for automatic smoke exhaust system compliance, except for power supply wiring to exhaust fans (Clause S21C7(7) of BCA Specification 21).

The above notwithstanding, compliance with the provisions of AS 1668.1 is considered a good industry good; hence any deviations from the provisions of AS 1668.1 should be addressed as a performance-based design.

Clause 4.6 of AS 1668.1-2015 states that the noise level in occupied spaces during operation of the smoke control systems shall not exceed 65 dB. Where the internal occupied ambient noise exceeds 60 dB, the smoke control system shall not exceed 5 dB above the internal occupied ambient noise levels, to a maximum level of 80 dB.

### 24.2 Performance Solution

The existing smoke exhaust fans (SEFs) located in the Myer retail mall and Plaza generate noise levels that exceed 80 dB (up to 90 dB) measured at First Floor, which does not comply with the provisions of Clause 4.6 of AS 1668.1-2015. The SEFs are retained, and the impact of the increased noise levels is assessed in this Performance Solution.

### 24.3 Relevant Performance Requirements

The relevant Performance Requirement has been identified as E2P2.

### 24.4 Assessment Method

The assessment method adopted is BCA Assessment Method A2G2(2)(b)(ii), i.e. “*other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements*”.

### 24.5 Intent of the BCA

The intent of Performance Requirement E2P2 (formerly EP2.2) is to provide occupants with sufficient “*time to evacuate before the onset of untenable conditions*”. The Guide to the BCA identifies the untenable conditions as: “*dangerous temperatures, low visibility and dangerous levels of toxicity*”.

It is evident that for a successful completion of an emergency evacuation a building must be provided with a smoke hazard management system that facilitates timely response from occupants.

A smoke exhaust system that generates increased noise levels may interfere with occupants’ ability to hear the fire alarm and therefore may result in a delayed response to an emergency.

## 24.6 Assessment Methodology

The purpose of this assessment is to demonstrate that the increased noise levels emitted by the existing SEFs will not delay occupant evacuation.

If Myer retail mall and Plaza are provided with fire safety measures (EWIS and visual alarm devices) that would prompt occupants to commence evacuation even if the noise levels generated by the existing SEFs exceed 80 dB, then compliance with Performance Requirement E2P2 is achieved.

The assessment methodology adopted for this Performance Solution is based on an absolute qualitative deterministic analysis in accordance with the following:

1. Determine the noise levels emitted by the existing SEFs in the Myer retail mall and Plaza smoke zones.
2. Identify the characteristics of the occupant warning system provided in the Myer retail mall and Plaza smoke zones and determine whether the emergency warning messages can be heard when SEFs are operating.
3. If the noise levels could compromise interpretation of the warning messages, develop an enhanced occupant warning strategy that would prompt occupants to commence evacuation when the SEFs are operating.

## 24.7 Acceptance Criteria

The acceptance criterion for this assessment is:

1. *The increased noise levels emitted by the existing SEFs must not adversely affect the ability of occupants to interpret audible and visual warnings in the fire-affected area as a cue to commence evacuation.*

## 25. References

- ABCB, 2005a: “*International Fire Engineering Guidelines, Edition 2005*”, Australian Building Codes Board, Canberra, Australia – Section 2.7.1.2, p. 2.7-5.
- ABCB, 2005b: “*International Fire Engineering Guidelines, Edition 2005*”, Australian Building Codes Board, Canberra, Australia – Section 2.7.2, Figure 2.7.2, p. 2.7-7.
- ABCB, 2005c: “*International Fire Engineering Guidelines, Edition 2005*”, Australian Building Codes Board, Canberra, Australia – Section 3.4.1, Table 3.4.1b, p. 3.4-8.
- ABCB, 2020: “*National Construction Code, Guide to Volume One, 2019, Amendment 1*”, Australian Building Codes Board, Canberra.
- ABCB, 2022: “*National Construction Code, Volume One, Building Code of Australia 2022*”, Australian Building Codes Board, Canberra.
- ABCB, 2021: “*Australian Fire Engineering Guidelines 2021*”, Australian Building Codes Board, Canberra, Australia.
- ABCB, 2021a: “*Australian Fire Engineering Guidelines 2021*”, Australian Building Codes Board, Canberra, Australia – Section 2.1.1, Table 2.1.1, p. 28.
- BCC, 2000a: “*Guide for the design of fire resistant barriers and structures*”, Building Control Commission, Australia – Section 3.6.2.2, pp. 29-30.
- BCC, 2000b: “*Guide for the design of fire resistant barriers and structures*”, Building Control Commission, Australia – Section 3.10.3, Equation 3.39, p. 53.
- Buchanan, A.H., 2001: “*Fire engineering design guide, Second edition*”, Centre for Advanced Engineering, Christchurch, New Zealand – Section 4.3, pp. 29-33.
- DFES 2021: “*Guideline No: GL-03 – Fire Safety Equipment Signage, March 2023*”, Government of Western Australia; Department of Fire & Emergency Services – Section 05 – “On-site Hydrant”.
- DFES 2023: “*Guideline No: GL-11 – DFES Site Planning and Fire Appliance Specifications, February 2023*”, Government of Western Australia; Department of Fire & Emergency Services.
- EC1, 2002: “*Eurocode 1: Actions on Structures. Part 1-2: General Actions. Actions on structures exposed to fire. Final Draft. EN 1991-1-2*”, European Committee for Standardization, Brussels, Belgium.
- FCRRP, 1998a: “*Fire Safety in Shopping Centres – Final Research Report, Project 6*”, Fire Code Reform Research Program, Sydney, Australia – Section 10.3.4.2, Table 10.3, p. 67.
- FCRRP, 1998b: “*Fire Safety in Shopping Centres – Final Research Report, Project 6*”, Fire Code Reform Research Program, Sydney, Australia – Section 11.4.3, p. 91.
- FCRRP, 1998c: “*Fire Safety In Shopping Centres – Final Research Report, Project 6*”, Fire Code Reform Research Program, Sydney, Australia – Section 10.3.3, p. 66.
- FMC, 2013a: “*SPRINKLER – Sprinkler Activation Simulation Computer Model*”, Part of the FireWind 3.6 package – Fire Modelling and Computing Pty. Ltd., Australia.
- Gwynne, S. V. M. and Rosenbaum, E. R., 2016a: “*The SFPE Handbook of Fire Protection Engineering, Fifth Edition – Employing the Hydraulic Model in Assessing Emergency Movement*”, the Society of Fire Protection Engineers, Quincy, Massachusetts, USA – Section 59.
- Marryatt, H.W., 1988: “*Fire: a century of automatic sprinkler protection in Australia and New Zealand, 1886-1986*”, Melbourne, Australia – Section 4, Table 3, p. 90.



- MBIE, 2020: “*C/VM2 – Verification Method: Framework for Fire Safety Design – For New Zealand Building Code Clauses C1-C6 Protection from Fire, Amendment 6*”, Ministry of Business, Innovation and Employment, Wellington 6140, New Zealand – p. 30, Table 2.2.
- NFSN/NFCC, 2017: “*Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: an Analysis from Fire Service Data*”, National Fire Sprinkler Network and National Fire Chiefs Council, UK.
- Richardson, J., 1983: “*An assessment of the performance of automatic sprinkler systems*”, Fire Technology, 19 – pp. 275-279.
- Rohr, K.D., 2003: “*U.S. experience with sprinklers*”, Quincy, MA; National Fire Protection Association, Fire Analysis and Research Division, USA – Table 12, p. 46.
- Thomas, P.H., 1981: “*Testing products and materials for their contribution to flashover in rooms*”, F. and Matls., Volume 5, Issue 3, pp. 103-111.

## 26. Appendix A – Assumptions and Limitations

The following assumptions and limitations apply to this report:

- a) The assessment provided in this report is limited to the analysis of fire safety; specifically, the ability of the performance-based building design to satisfy the BCA Performance Requirements in respect to fire safety arising out of accidental fires and arson attacks of opportunity (i.e., arson attacks that use ignition sources readily available in the building, and do not involve use of accelerants and/or tampering with the installed fire safety measures). The assessment only takes into consideration fires originating from a single source, with fuel load and distribution compatible with the use of the area under consideration. Acts of premeditated arson (i.e., introduction of accelerants; fuel loads that are not typical for the area under consideration; tampering with fire safety measures), terrorism or any other fires initiated due to malicious acts of one or more individuals are specifically excluded from the scope of the assessment.
- b) The assessment specifically excludes assessment of all other types of emergency situations and assumes that suitable measures will be set in place to handle those types of emergencies. The building surveyor and/or permit authority must ensure that they are satisfied that the performance-based building design has adequate provisions for life safety in emergency situations other than those originating from accidental fires or arson attacks of opportunity.
- c) The report specifically excludes assessment of property damage / loss of business continuity as a result of a fire; or insurer requirements; or environmental protection requirements, unless specifically stated otherwise in this report. The assessment is based on the objectives of the BCA as outlined in Section 2.1.
- d) The Performance Solution(s) is(are) developed to demonstrate compliance with the BCA Performance Requirements and may not provide the level of property protection inherent in a BCA DtS compliant design.
- e) The BCA Performance Requirements identified in this report may have parts which are not entirely fire safety related and which are not specifically covered by this fire safety engineering assessment. Such aspects include but are not limited to general occupational health and safety matters (i.e., safety during day-to-day operations, or during emergencies other than emergencies arising from accidental fires), and access and amenity. The building surveyor and/or permit authority or other specialist parties shall be responsible for assessing and certifying the ability of the design to satisfy those portions of the BCA Performance Requirements that are not fire safety related and for ensuring that the design provides adequate safety for day-to-day operation and/or emergencies other than those arising from accidental fires.
- f) This report relies on third parties for the identification of non-compliances with the BCA DtS provisions. BCA Consultants take no responsibility for the accuracy of the information provided by third parties.

- g) This report may in parts rely on input from stakeholders to develop an appropriate fire engineering brief (FEB) criteria and assessment parameters. Fire scenarios, identified during the FEB process as being worst credible fire scenarios, are considered representative of such scenarios. This report does not assess system performance and the ability of the design to meet the BCA Performance Requirements for fire scenarios that are more severe or hazardous than the fire scenarios identified as requiring assessment. Fire engineering methodologies and acceptance criteria identified during the FEB process as being appropriate for this project are considered appropriate for justifying compliance with the BCA Performance Requirements. Acceptance of this report by the stakeholders is considered to be acceptance that the report satisfies the requirements set out in the FEB.
- h) The FSER may use in parts comparative assessment to determine compliance with the BCA Performance Requirements and relies on the BCA DtS provisions to achieve an adequate level of fire safety.
- i) This fire safety engineering assessment aims to provide appropriate supporting evidence demonstrating that the Performance Solutions are capable of satisfying the nominated BCA Performance Requirements in respect to fire safety. This report may in parts rely on:
  - 1. The accuracy of conclusions and opinions drawn in past research when assessing the level of performance achieved by the performance-based design.
  - 2. The opinions of the fire engineers and other stakeholders working on the project in respect to the intent of the BCA Performance Requirements (i.e., the BCA DtS provisions require the fire safety design to facilitate the safe evacuation of the occupants; however, no fire safety design can guarantee occupants will be safe in the event of a fire). This report has been produced on the basis that new fire safety designs need to provide suitable measures that can be shown (using appropriate supporting evidence) to either facilitate the safe evacuation of the occupants in the event of identified reasonable worst credible fire scenarios; or provide at least equivalent fire safety performance to a design complying with the BCA DtS provisions).
  - 3. Opinions of other professionals as part of the FEB process (i.e., in confirming acceptance of nominated reasonable worst credible fire scenarios and appropriate assessment methodologies, tenability criteria and acceptance criteria, etc.).
  - 4. Opinion of the building surveyor and/or permit issuing authority in respect of the suitability of the selected base case BCA DtS compliant designs used for comparative assessments.
  - 5. Modelling tools developed by other organisations as a means of assessing performance.
  - 6. Minimum BCA DtS provisions for achieving an acceptable level of fire safety and compliance with the BCA Performance Requirements.

- j) This FEB has been produced and issued by BCA Consultants and any intellectual property contained within this report is to remain the property of BCA Consultants and must not be distributed to parties except for those directly involved in the project to which this report relates without written approval of BCA Consultants.

## **27. Appendix B – DFES FEB Meeting Minutes**

The following is a copy of the minutes for the FEB Meeting with DFES on 22 April 2025 prepared by BCA Consultants (WA) Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.



**CLIENT/DEPARTMENT:** Multiplex  
**PROJECT/SUBJECT:** Galleria Schopping Centre  
**PURPOSE:** FEB meeting  
**DATE:** 22/04/2025 **STARTED:** 9.00am **FINISHED:** 10.00am  
**LOCATION:** DFES Built Environment Branch (Teams Meeting)  
**OUR REFERENCE:** 20240380-E0302-Mn-0001  
**PRESENT:**

| Name               | Company/Position                          | Contact                                                                                  | Initials |
|--------------------|-------------------------------------------|------------------------------------------------------------------------------------------|----------|
| Brendan O'Regan    | DFES – Fire Engineer                      | <a href="mailto:Brendan.O'Regan@dfes.wa.gov.au">Brendan.O'Regan@dfes.wa.gov.au</a>       | BO'R     |
| Alexis Wake        | DFES – Building Fire Safety Officer       | <a href="mailto:Alexis.Wake@dfes.wa.gov.au">Alexis.Wake@dfes.wa.gov.au</a>               | AW       |
| Kylie Judd         | Multiplex – Project Manager               | <a href="mailto:Kylie.Judd@multiplex.global">Kylie.Judd@multiplex.global</a>             | KJ       |
| Vincent Chi        | Buchan – Architect                        | <a href="mailto:Vincent.Chi@buchan.au">Vincent.Chi@buchan.au</a>                         | VC       |
| Nick Rae           | Buchan – Architect                        | <a href="mailto:Nick.Rae@buchan.au">Nick.Rae@buchan.au</a>                               | NR       |
| Nikola Stojanovic  | Build Plus Group – Project manager client | <a href="mailto:nik.stojanovic@buildplusgroup.com">nik.stojanovic@buildplusgroup.com</a> | NS       |
| Mark Viska         | BCA – Building Surveyor                   | <a href="mailto:mviska@bcagroup.com.au">mviska@bcagroup.com.au</a>                       | MV       |
| Chris Meisinger    | BCA – Fire Engineer                       | <a href="mailto:cmeisinger@bcagroup.com.au">cmeisinger@bcagroup.com.au</a>               | CM       |
| Alex Alexandrovski | BCA – Fire Safety Engineer                | <a href="mailto:aalexandrovski@bcagroup.com.au">aalexandrovski@bcagroup.com.au</a>       | AA       |
| Amy Chao           | BCA – Fire Safety Engineer                | <a href="mailto:achao@bcagroup.com.au">achao@bcagroup.com.au</a>                         | AC       |

### APOLOGIES:

| Name         | Company/Position | Contact | Initials |
|--------------|------------------|---------|----------|
| No apologies |                  |         |          |

### OBJECTIVE:

Present the fire safety strategy for the project to DFES and agree on the methodology to document the proposed Performance Solutions.

| Item  | Topic                                                                                                                                                                                                                                                                                                        | Who                                                     | Due Date   |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------|
| Note: | <i>We believe the following record to be an accurate summary of decisions and related discussions. We will appreciate notification of exceptions to this record within three (3) business days of its receipt. Failing such notification, we will consider this a statement of fact in which you concur.</i> | BO'R,<br>AW, KJ,<br>VC, NS,<br>NR, MV,<br>CM, AC,<br>AA | 30.04.2025 |
| 1.    | Acceptance of previous minutes: No Previous Minutes                                                                                                                                                                                                                                                          |                                                         |            |
| 2.    | General                                                                                                                                                                                                                                                                                                      |                                                         |            |
| 2.1.  | AA started the meeting by introducing the project.                                                                                                                                                                                                                                                           |                                                         |            |
| 2.2.  | The previous design was completed by Arup; BCA Consultants has now taken over.                                                                                                                                                                                                                               |                                                         |            |
| 2.3.  | The scope of works has slightly changed from the previous design by Arup. The work is now limited to the central part of the mall, with a new Timezone tenancy and minor extensions to JD Sports and the tenancies along the southeast side adjacent to Rebel Sport.                                         |                                                         |            |

| Item      | Topic                                                                                                                                                                                                                                                 | Who | Due Date |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 2.4.      | The two circular stairs (previously part of the food court) located on the south side are to be removed, and the food court will be converted into a JB Hi-Fi store.                                                                                  |     |          |
| 2.5.      | Myer is fire-separated from the rest of the mall by fire-rated sliding doors that close upon fire alarm activation.                                                                                                                                   |     |          |
| <b>3.</b> | <b>Perf. Sol. 1 – Reduction in structural fire rating</b>                                                                                                                                                                                             |     |          |
| 3.1.      | MV explained that, generally, all areas with three storeys—including Myer and the plant rooms—are fire separated from the rest of the centre. Hence, the shopping mall is classified as Type B Construction, which requires a 180-minute fire rating. |     |          |
| 3.2.      | AA followed by explaining that the proposed Performance Solution is to reduce the fire rating requirement from nominal 180 minutes to 120 minutes.                                                                                                    |     |          |
| 3.3.      | The proposed approach is to carry out a burnout calculation using the Eurocode, Law and CIB W14 formulae.                                                                                                                                             |     |          |
| 3.4.      | As the building is sprinkler-protected, the assessment will concentrate on a redundancy scenario assuming sprinkler failure.                                                                                                                          |     |          |
| 3.5.      | A 75% glass breakage will be used for the sprinkler failure scenario.                                                                                                                                                                                 |     |          |
| 3.6.      | BO'R commented that DFES recommend a 50% glass breakage.                                                                                                                                                                                              |     |          |
| 3.7.      | AA noted DFES's comments and will look into it.                                                                                                                                                                                                       |     |          |
| 3.8.      | BO'R asked about the slab.                                                                                                                                                                                                                            |     |          |
| 3.9.      | AA responded that it is a reinforced concrete slab, which would inherently provide a fire rating. However, this will need to be confirmed with the structural engineer for the exact rating provided.                                                 |     |          |
| 3.10.     | BO'R acknowledged the comments.                                                                                                                                                                                                                       |     |          |
| <b>4.</b> | <b>Perf. Sol. 2 – Extended travel distances in areas without smoke exhaust</b>                                                                                                                                                                        |     |          |
| 4.1.      | Extended travel distances to a single exit or a point of choice are capped at 30 metres.                                                                                                                                                              |     |          |
| 4.2.      | A proposed quantitative comparative assessment will be carried out, comparing the Deemed-to-Satisfy (DtS) sprinkler detection time to the performance-based smoke detection time, i.e. a comparison of DtS RSET time versus performance-based RSET.   |     |          |
| 4.3.      | BO'R had no objections.                                                                                                                                                                                                                               |     |          |
| <b>5.</b> | <b>Perf. Sol. 3 – Extended travel distances in areas with smoke exhaust</b>                                                                                                                                                                           |     |          |
| 5.1.      | Extended travel distances between alternative exits and to the nearest of the alternative exits were discussed.                                                                                                                                       |     |          |
| 5.2.      | The proposed solution is to maintain tenable conditions in the retail malls for the duration of occupant evacuation.                                                                                                                                  |     |          |
| 5.3.      | The existing smoke exhaust system has multiple exhaust points. The size of the system will be determined through CFD modelling.                                                                                                                       |     |          |
| 5.4.      | There are no smoke baffles in the retail mall, so the smoke reservoir length will exceed 60 metres.                                                                                                                                                   |     |          |

| Item      | Topic                                                                                                                                                                                                                           | Who | Due Date |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 5.5.      | BO'R noted that DFES provided response to ARUP report and advised that incorporating original DFES comments into the current report would resolve most of DFES concerns.                                                        |     |          |
| 5.6.      | DFES also commented that they disagree with the medium fire size proposed by ARUP.                                                                                                                                              |     |          |
| 5.7.      | AA responded that fast fire growth scenarios will be used as the base case, along with the failure of the largest smoke exhaust fan as a redundancy fire scenario.                                                              |     |          |
| 5.8.      | BO'R had no objection.                                                                                                                                                                                                          |     |          |
| 5.9.      | AA continued that the Rebel Sport and Timezone tenancies will have smoke exhaust systems that are Deemed-to-Satisfy (DtS) compliant.                                                                                            |     |          |
| 5.10.     | For the JB Hi-Fi tenancy, smoke exhaust provision will depend on the selling floor area.                                                                                                                                        |     |          |
| 5.11.     | If the area is less than 1,000 m <sup>2</sup> , smoke exhaust will be omitted; otherwise, it will be provided.                                                                                                                  |     |          |
| 5.12.     | BO'R had no objection to the proposed smoke exhaust approach.                                                                                                                                                                   |     |          |
| 5.13.     | BO'R asked about occupant egress from tenancies with an alternative exit leading directly to the outside.                                                                                                                       |     |          |
| 5.14.     | ARUP proposed that all occupants from such tenancies will use the external exit and not re-enter the mall. DFES disagrees with this approach.                                                                                   |     |          |
| 5.15.     | DFES believes that if the mall is the main entrance, occupants are likely to re-enter the mall.                                                                                                                                 |     |          |
| 5.16.     | AA explained that BCA Consultants propose a 50/50 occupant split in such tenancies if the main entrance is connected to the mall.                                                                                               |     |          |
| 5.17.     | This approach is based on Project 6, and evacuation will be modelled using Pathfinder.                                                                                                                                          |     |          |
| 5.18.     | BO'R had no objection.                                                                                                                                                                                                          |     |          |
| 5.19.     | AA added that the two curved stairs are being removed. A new internal stair will be provided to replace the curved stairs.                                                                                                      |     |          |
| 5.20.     | Smoke detection will be installed in the tenancies adjacent to the balcony.                                                                                                                                                     |     |          |
| 5.21.     | BO'R asked whether the new internal stair will be fire-isolated.                                                                                                                                                                |     |          |
| 5.22.     | AA responded that the stair will be smoke-separated only, as it connects just two levels.                                                                                                                                       |     |          |
| <b>6.</b> | <b>Perf. Sol. 4 –Fire isolated corridors discharge into covered areas</b>                                                                                                                                                       |     |          |
| 6.1.      | The discharge of fire-isolated corridors into covered areas or fenced loading dock was discussed.                                                                                                                               |     |          |
| 6.2.      | Potential solutions are still being considered. Dynamic signage may be provided if the escape path could be compromised.                                                                                                        |     |          |
| 6.3.      | BO'R asked, in scenarios where occupants egress into a fenced off loading dock, whether the exit gates in the fence can be located closer to the exit doors to avoid the need to traverse the loading dock to reach open space. |     |          |

| Item       | Topic                                                                                                                                                                                                                                                                                                                                                      | Who | Due Date |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 6.4.       | AA will look into this.                                                                                                                                                                                                                                                                                                                                    |     |          |
| 6.5.       | BO'R also inquired about egress widths.                                                                                                                                                                                                                                                                                                                    |     |          |
| 6.6.       | AA confirmed that all egress routes will be modelled, and any minor shortfalls in width (if present) will be identified and addressed in the Fire Safety Engineering Report (FSER).                                                                                                                                                                        |     |          |
| 6.7.       | BO'R agreed and noted that DFES will review the FSER to understand the egress discharge provisions, with particular attention to the availability of alternative exits.                                                                                                                                                                                    |     |          |
| <b>7.</b>  | <b>Perf. Sol. 5 – Class 6 exits discharge into non-compliant areas</b>                                                                                                                                                                                                                                                                                     |     |          |
| 7.1.       | Discharge into a roofed car park, which is a separate building but connected to the retail mall, was discussed.                                                                                                                                                                                                                                            |     |          |
| 7.2.       | Once occupants leave the retail building, they are considered to be in a place of relative safety.                                                                                                                                                                                                                                                         |     |          |
| 7.3.       | BO'R had no objections.                                                                                                                                                                                                                                                                                                                                    |     |          |
| <b>8.</b>  | <b>Perf. Sol. 6 – Fire hose coverage</b>                                                                                                                                                                                                                                                                                                                   |     |          |
| 8.1.       | The proposed approach is to provide two lengths of hose for internal hydrants within the mall (i.e. hydrants spaced 25-30 metres apart within the mall). However, 2 lengths of hose used to reach into deeper tenancies.                                                                                                                                   |     |          |
| 8.2.       | BO'R asked whether the hydrants are existing.                                                                                                                                                                                                                                                                                                              |     |          |
| 8.3.       | AA responded that some hydrants may be changed or replaced and confirmed this will be looked into.                                                                                                                                                                                                                                                         |     |          |
| 8.4.       | BO'R noted that DFES prefers hydrants to be spaced at 24 metres apart but will accept 25–30 metres in areas where a 24-metre spacing is not achievable due to layout constraints. However, DFES prefers internal hydrants within large tenancies if adequate coverage cannot be achieved from two directions (i.e. from the retail mall and from outside). |     |          |
| <b>9.</b>  | <b>Perf. Sol. 7 – Extinguishers in lieu of Fire Hose Reels</b>                                                                                                                                                                                                                                                                                             |     |          |
| 9.1.       | Fire extinguishers are proposed in lieu of fire hose reels throughout the mall, except in the car park and major tenancies.                                                                                                                                                                                                                                |     |          |
| 9.2.       | BO'R had no objection to the proposal.                                                                                                                                                                                                                                                                                                                     |     |          |
| <b>10.</b> | <b>Perf. Sol. 8 – Omission of sprinklers from particular parts</b>                                                                                                                                                                                                                                                                                         |     |          |
| 10.1.      | AA explained that sprinklers are proposed to be omitted from the north laneway canopy.                                                                                                                                                                                                                                                                     |     |          |
| 10.2.      | VC added that the canopy is constructed of lightweight steel with a solid polycarbonate roof.                                                                                                                                                                                                                                                              |     |          |
| 10.3.      | BO'R noted that if the canopy is non-combustible and fuel loads are managed, the omission may be acceptable.                                                                                                                                                                                                                                               |     |          |
| 10.4.      | AA clarified that polycarbonate is combustible and has a low melting temperature.                                                                                                                                                                                                                                                                          |     |          |
| 10.5.      | BO'R responded that if it can be justified that fire spread is not a concern—due to surrounding sprinkler protection, absence of nearby fire sources, and appropriate design—then the omission may be acceptable.                                                                                                                                          |     |          |

| Item       | Topic                                                                                                                                                                                     | Who | Due Date |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 10.6.      | AA acknowledged this.                                                                                                                                                                     |     |          |
| 10.7.      | AA continued that the roofs of the atrium and of the Meyer Mall are not sprinkler-protected and that the proposed assessment will consider any potential fuel load below these roofs.     |     |          |
| 10.8.      | BO'R asked whether a larger fire size will be considered in the CFD modelling.                                                                                                            |     |          |
| 10.9.      | AA confirmed that this is the intention.                                                                                                                                                  |     |          |
| 10.10.     | AA further noted that the southeast extension of the first-floor tenancy has created a 'covered walkway' on the ground floor below. Sprinklers are proposed to be omitted from this area. |     |          |
| 10.11.     | Management will be asked to ensure no fire load is present in this walkway. If that cannot be assured, sprinklers will be installed.                                                      |     |          |
| 10.12.     | The walls are not fire-rated but are made of concrete slabs and walls.                                                                                                                    |     |          |
| 10.13.     | BO'R had no objection, on the understanding that it is essentially a 'covered walkway' with no fire load present.                                                                         |     |          |
| <b>11.</b> | <b>Perf. Sol. 9 – Omission of fire-resistant cabling to the AHUs</b>                                                                                                                      |     |          |
| 11.1.      | AA explained that in a worst-case scenario, four AHUs (air handling units) will be lost, but there will still be enough AHUs to support the operation of the smoke exhaust system.        |     |          |
| 11.2.      | BO'R asked whether a reduced AHU scenario, such as after-hours operation, will be considered.                                                                                             |     |          |
| 11.3.      | AA will check the operations after-hours. The original design, as understood, is that all doors will open on fire alarm at all times.                                                     |     |          |
| 11.4.      | BO'R asked whether security will be in place if all doors are open during nighttime.                                                                                                      |     |          |
| 11.5.      | AA responded that, to our understanding, security will be in place during such occasions.                                                                                                 |     |          |
| <b>12.</b> | <b>Perf. Sol. 10 – Existing smoke exhaust fans produce noise levels exceed maximum prescribed</b>                                                                                         |     |          |
| 12.1.      | Noise levels produced by the existing smoke exhaust fans will be assessed to determine whether they interfere with alarm signals.                                                         |     |          |
| 12.2.      | BO'R suggested the use of visual alarms.                                                                                                                                                  |     |          |
| 12.3.      | AA responded that visual alarms will be considered if noise levels could interfere with the alarms.                                                                                       |     |          |
| 12.4.      | DFES had no further comments regarding the proposed performance solution.                                                                                                                 |     |          |
| <b>13.</b> | <b>EWIS system</b>                                                                                                                                                                        |     |          |
| 13.1.      | BO'R asked whether the EWIS (Emergency Warning and Intercommunication System) covers the entire shopping centre.                                                                          |     |          |
| 13.2.      | BO'R explained that the DFES records indicate that the existing parts of the mall do not have EWIS coverage. This may fall outside the current scope.                                     |     |          |



| Item  | Topic                                                                                                           | Who | Due Date   |
|-------|-----------------------------------------------------------------------------------------------------------------|-----|------------|
| 13.3. | KJ responded that she will resolve this with the client and confirm the coverage as part of the FEB submission. | KJ  | 30.04.2025 |

**Next Meeting:** N/A

**Location:**

**Chair:** Alex Alexandrovski **Title:** Senior Fire Engineer

**PREPARED BY:** Amy Chao

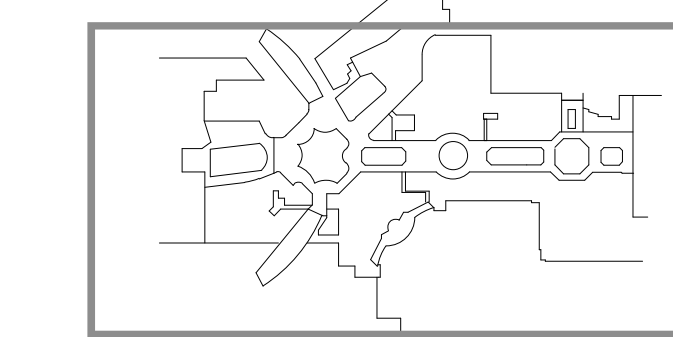
**DISTRIBUTION:** All present

## **28. Appendix C – Fire Rated Corridors**

The following is a copy of the markup within the area of scope that identified the fire rated corridors.

The document is included in its entirety and the original page numbering is maintained.





Do not scale this drawing. Verify all dimensions on site before commencing any work. This drawing remains the property of The Buchanan Group Melbourne Pty Ltd. Reproduction in whole or in part without prior written consent of Buchanan is forbidden. All rights reserved. Copyright © 2025 Buchanan

File: Autodesk Docs\\19049-R24-Galleria\\GAL-BUC-AR-MOD-BUILD.rvt

| LEGEND                                                                                                         |                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                | BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY |
|                                                                                                                | SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT                                                  |
|                                                                                                                | NEW FLOOR                                                                                                            |
|                                                                                                                | EXISTING FLOORS/WALLS                                                                                                |
|                                                                                                                | EXISTING DRAIN PITS LOCATION                                                                                         |
|                                                                                                                | EXISTING SERVICES PITS LOCATION                                                                                      |
| ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120' - REFER TO STRUCTURAL ENG. DOCUMENTATION |                                                                                                                      |

| BCA Legend |                         |
|------------|-------------------------|
|            | Fire rated corridor     |
|            | Non fire rated corridor |

Rev. A 06.05.2025

Considered as non-fire-rated corridor.  
Sprinklers to be provided into the corridor and stairs.



PERRON GROUP

## GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number  
**19049A**

Status  
**TENDER**

Date Plotted  
17/04/2025 5:50:40 PM

Scale  
As indicated @A0

Drawing Title  
**GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY**

Drawing Number  
**GAL-BUC-AR-04-0L-0-18001**

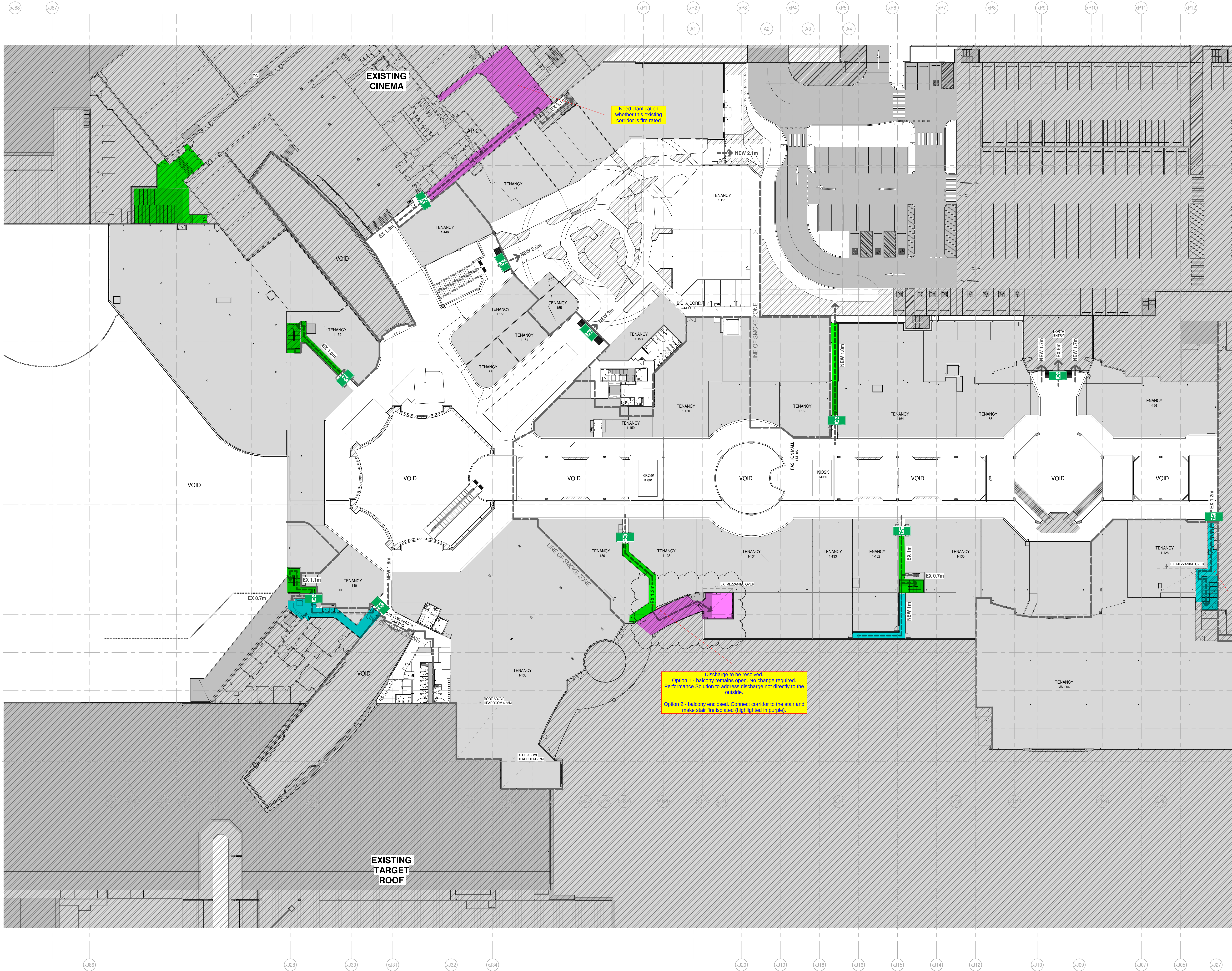
Revision  
**B**

# BUCHANAN

Perth Studio  
+ 61 8 9211 9898 / [buchan.au](http://buchan.au)

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION





| LEGEND                                                                                                         |                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
|                                                                                                                | BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY. |
|                                                                                                                | SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT.                                                  |
|                                                                                                                | NEW FLOOR                                                                                                             |
|                                                                                                                | EXISTING FLOORS/WALLS                                                                                                 |
|                                                                                                                | EXISTING DRAIN PITS LOCATION                                                                                          |
|                                                                                                                | EXISTING SERVICES PITS LOCATION                                                                                       |
| ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120' - REFER TO STRUCTURAL ENG. DOCUMENTATION |                                                                                                                       |

| BCA Legend |                         |
|------------|-------------------------|
|            | Fire rated corridor     |
|            | Non fire rated corridor |

Rev. A 06.05.2025

Considered non fire rated corridor.  
Sprinklers to be provided into the corridor and stairs.



PERRON GROUP

## GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number  
19049A

Status  
TENDER

Date Plotted  
17/04/2025 5:50:09 PM

Scale  
As indicated @A0

0 2.5 5 10 15 20M

Drawing Title

FIRST FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number

GAL-BUC-AR-04-1L-0-18003

Revision

B

# BUCHAN

Perth Studio  
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION



## **29. Appendix D – Fire Hydrant Coverage Plans**

The following is a copy of the “Fire Hydrant Coverage” plans for the GSC within the area of scope prepared by Firesafe Group Pty Ltd.

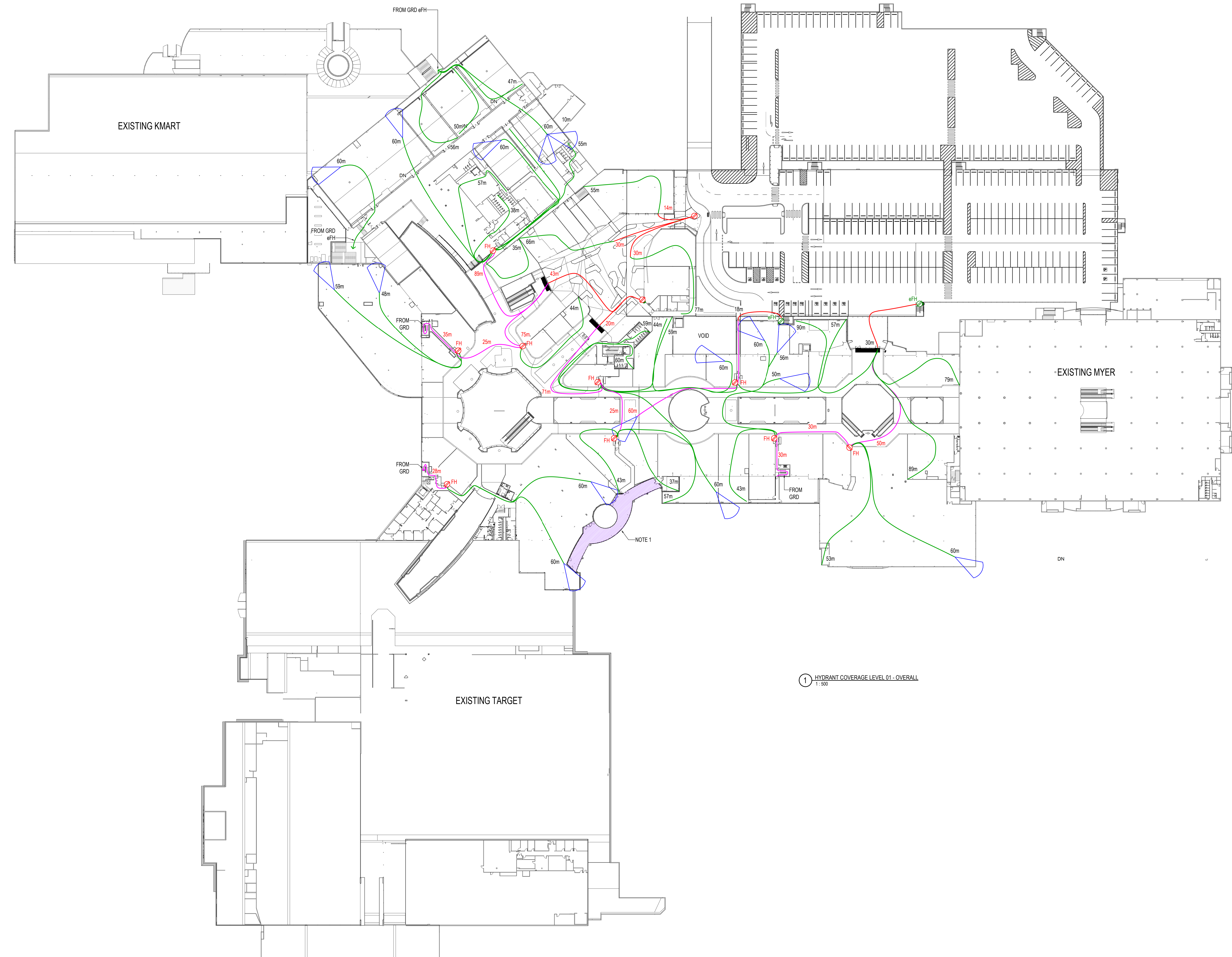
The document is included in its entirety and the original page numbering is maintained.





|             |             |      |
|-------------|-------------|------|
| PROJECT NO: | DRAWING NO: | REV: |
|-------------|-------------|------|





|                |             |                     |                     |
|----------------|-------------|---------------------|---------------------|
| DRAWN:<br>DM   |             | SCALE:<br>1:500     | SHT SIZE:<br><br>AC |
| CHECKED:<br>RB |             | DATE:<br>29.04.2025 |                     |
| PROJECT NO:    | DRAWING NO: |                     |                     |

**COPYRIGHT NOTICE:** FIRESAFE CONSTRUCTION © 2025 - ALL RIGHTS RESERVED. THIS DRAWING IS THE INTELLECTUAL PROPERTY OF FIRESAFE CONSTRUCTION AND IS PROTECTED BY COPYRIGHT LAWS - UNAUTHORISED REPRODUCTION, DISTRIBUTION OR USE OF THIS DRAWING, IN WHOLE OR IN PART, WITHOUT THE EXPRESS WRITTEN CONSENT OF FIRESAFE CONSTRUCTION IS STRICTLY PROHIBITED - FOR ENQUIRIES OR PERMISSIONS, PLEASE CONTACT (08) 9437 7777

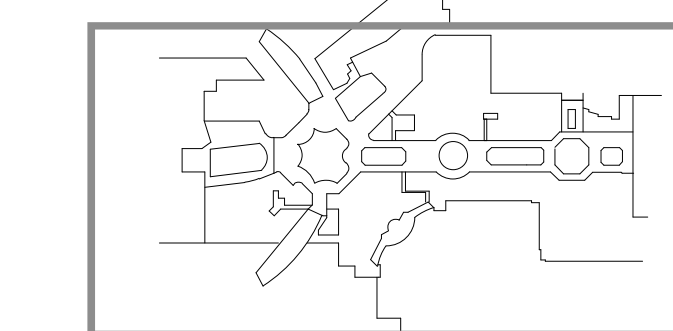


### **30. Appendix E – Smoke Zones**

The following is a copy of the markup within the area of scope, identifying the designated smoke zones.

The document is included in its entirety and the original page numbering is maintained.





Do not scale this drawing. Verify all dimensions on site before commencing any work. This drawing remains the property of The Buchanan Group Melbourne Pty Ltd. Reproduction in whole or in part without prior written consent of Buchanan is forbidden. All rights reserved. Copyright © 2025 Buchanan

File: Autodesk Docs//19049-R24-Galleria/GAL-BUC-AR-MOD-BUILD.rvt

| LEGEND                                                                                                       |                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|                                                                                                              | BUILDING WORKS TO REMAIN OR NOT IN SCOPE. ARCHITECTURAL SCOPE WITHIN TENANCIES LIMITED TO INTER-TENANCIES WALLS ONLY |
|                                                                                                              | SCOPE OF WORKS BY LANDSCAPE ARCHITECT. REFER TO LANDSCAPE ARCHITECT                                                  |
|                                                                                                              | NEW FLOOR                                                                                                            |
|                                                                                                              | EXISTING FLOORS/WALLS                                                                                                |
|                                                                                                              | EXISTING DRAIN PITS LOCATION                                                                                         |
|                                                                                                              | EXISTING SERVICES PITS LOCATION                                                                                      |
| ALL NEW AND UNPROTECTED EXISTING STRUCTURAL STEEL TO ACHIEVE FRL 120' REFER TO STRUCTURAL ENG. DOCUMENTATION |                                                                                                                      |



PERRON GROUP

## GALLERIA SHOPPING CENTRE

WALTER ROAD WEST, MORLEY WA

Project Number  
19049A

Status  
TENDER

Date Plotted  
17/04/2025 5:50:40 PM

Scale  
As indicated @A0

0 2.5 5 10 15 20M

Drawing Title  
GROUND FLOOR FRL EGRESS PLAN - DIAGRAM ONLY

Drawing Number  
GAL-BUC-AR-04-0L-0-18001

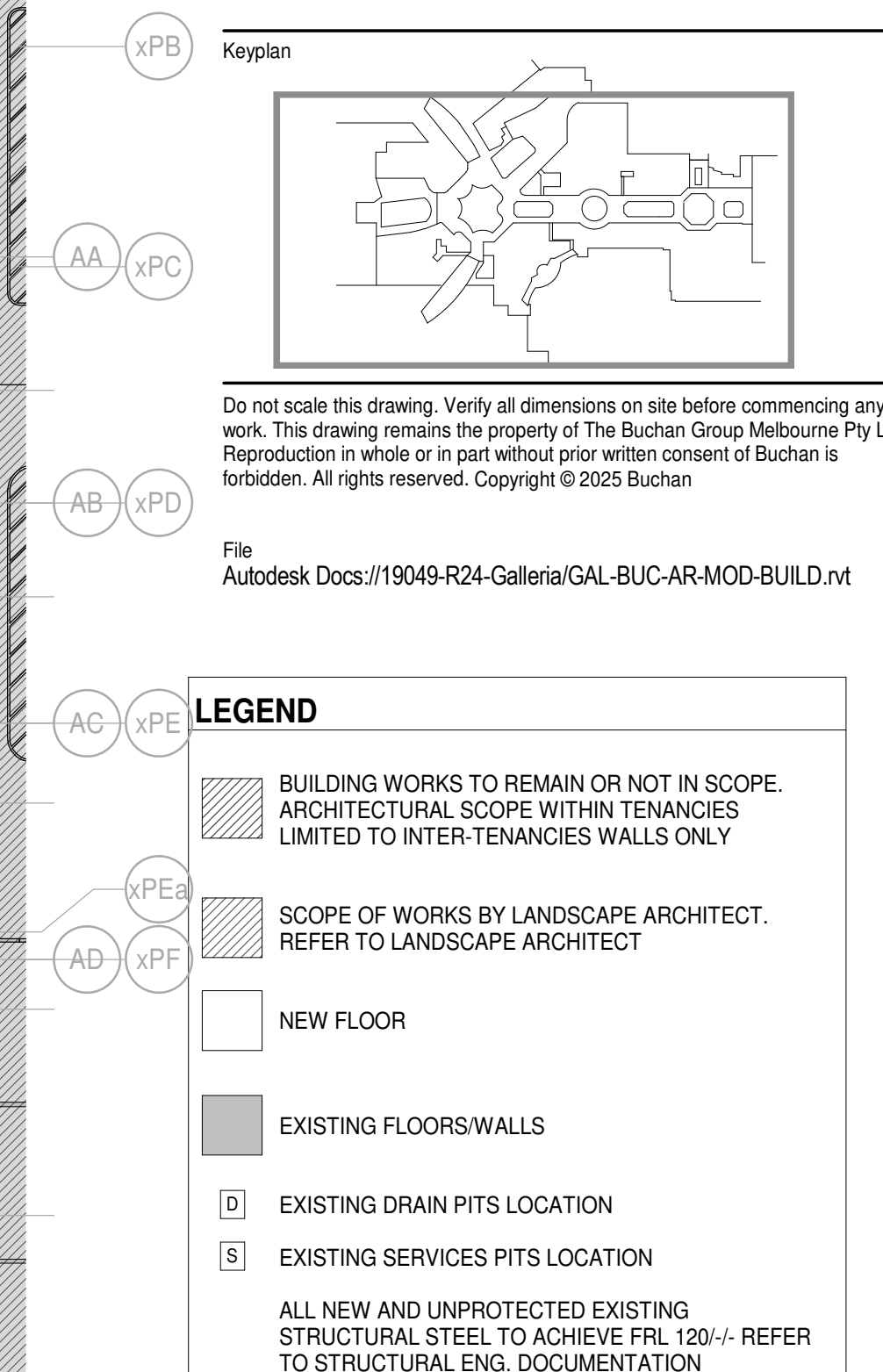
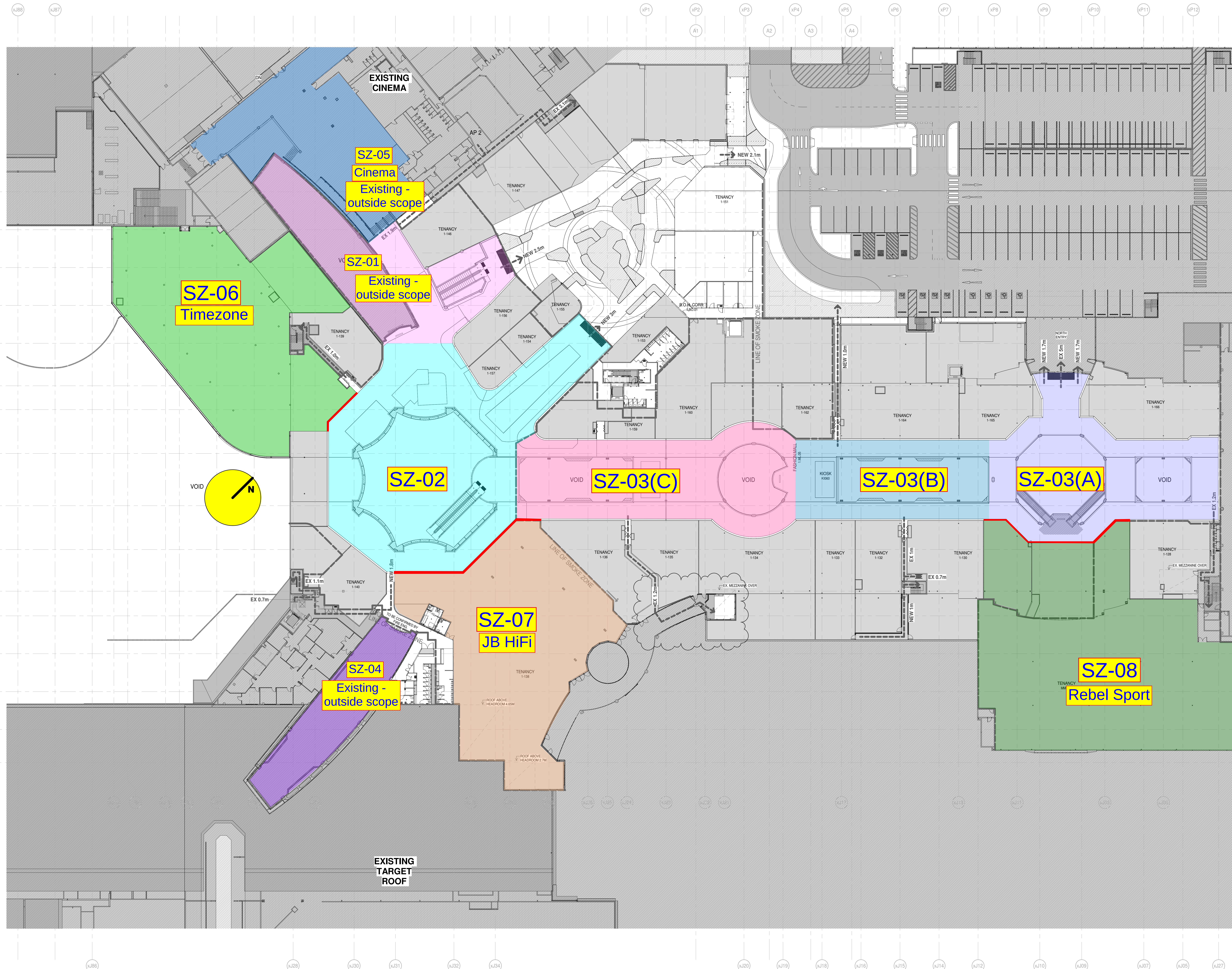
Revision  
B

# BUCHANAN

Perth Studio  
+ 61 8 9211 9898 / buchan.au

ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION





PERRON GROUP

**GALLERIA  
SHOPPING CENTRE**  
WALTER ROAD WEST, MORLEY  
WA

Project Number  
19049A

|        |        |
|--------|--------|
| Status | TENDER |
|--------|--------|

TENDER

Date Plotted 1/10/10 09:05:55 00 PM

Date Filed: 17/04/2025 5:50:09 PM

Page: 1 of 1

Scale As indicated @A0

Drawing Title

## FIRST FLOOR FRL EGRESS

PLAN - DIAGRAM ONLY

### PLAN DIAGRAM ONE

Drawing Number **GAL-PUC-AR-04-11-0-18002** Revision **B**

GAL-BUC-AR-04-1L-0-18003      B

---

\_\_\_\_\_

# BUCHAN

# BUCPAIN

## Discussion

**Perth Studio**  
01 9 0016 0000 / [perth.studio.com.au](http://perth.studio.com.au)

+ 61 8 9211 9898 / [buchan.au](http://buchan.au)

**ISSUE FOR TENDER ONLY / NOT FOR CONSTRUCTION**



### **31. Appendix F – DFES FEB Meeting No. 2 Minutes**

The following is a copy of the minutes for the second FEB Meeting with DFES on 3 June 2025 prepared by BCA Consultants (WA) Pty Ltd.

The document is included in its entirety and the original page numbering is maintained.

**CLIENT/DEPARTMENT:** Multiplex  
**PROJECT/SUBJECT:** Galleria Schopping Centre  
**PURPOSE:** FEB meeting  
**DATE:** 3/06/2025 **STARTED:** 10.00am **FINISHED:** 10.30am  
**LOCATION:** DFES Built Environment Branch (Teams Meeting)  
**OUR REFERENCE:** 20240380-E0302-Mn-0002  
**PRESENT:**

| Name               | Company/Position                    | Contact                                                                            | Initials |
|--------------------|-------------------------------------|------------------------------------------------------------------------------------|----------|
| Brendan O'Regan    | DFES – Fire Engineer                | <a href="mailto:Brendan.O'Regan@dfes.wa.gov.au">Brendan.O'Regan@dfes.wa.gov.au</a> | BO'R     |
| Shane Gobbee       | DFES – Building Fire Safety Officer | <a href="mailto:Shane.Gobbee@dfes.wa.gov.au">Shane.Gobbee@dfes.wa.gov.au</a>       | SG       |
| Alex Alexandrovski | BCA – Fire Safety Engineer          | <a href="mailto:aalexandrovski@bcagroup.com.au">aalexandrovski@bcagroup.com.au</a> | AA       |
| Amy Chao           | BCA – Fire Safety Engineer          | <a href="mailto:achao@bcagroup.com.au">achao@bcagroup.com.au</a>                   | AC       |

### APOLOGIES:

| Name         | Company/Position | Contact | Initials |
|--------------|------------------|---------|----------|
| No apologies |                  |         |          |

### OBJECTIVE:

Present the fire safety strategy for the project to DFES and agree on the methodology to document the proposed Performance Solutions.

| Item  | Topic                                                                                                                                                                                                                                                                                                        | Who                    | Due Date   |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------|
| Note: | <i>We believe the following record to be an accurate summary of decisions and related discussions. We will appreciate notification of exceptions to this record within three (3) business days of its receipt. Failing such notification, we will consider this a statement of fact in which you concur.</i> | BO'R,<br>SB, AA,<br>AC | 06.06.2025 |
| 1.    | <b>Acceptance of previous minutes: Minutes of FEB Meeting No. 1</b>                                                                                                                                                                                                                                          |                        |            |
| 2.    | <b>General</b>                                                                                                                                                                                                                                                                                               |                        |            |
| 2.1.  | AA began by describing changes to the fire safety strategy since the original scheme was presented to DFES on 22 April 2025.                                                                                                                                                                                 |                        |            |
| 2.2.  | Revision B of the FEB (Fire Engineering Brief) has already been submitted to DFES for review; however, as the project progressed, additional deviations have been identified that will be addressed in the revised FEB.                                                                                      |                        |            |
| 3.    | <b>Separation between sprinklers and non-sprinklered area.</b>                                                                                                                                                                                                                                               |                        |            |
| 3.1.  | Two areas (NW entry and North entry) are currently only separated by glazing between sprinklered and non-sprinklered zones.                                                                                                                                                                                  |                        |            |
| 3.2.  | No current works are being undertaken in these areas.                                                                                                                                                                                                                                                        |                        |            |
| 3.3.  | Future works may involve modifications to the Coles Click and Collect drive-thru (NW entry), but no works are proposed at the North entry.                                                                                                                                                                   |                        |            |
| 3.4.  | The proposed solution is carry out radiant heat flux assessment from the nearest vehicles.                                                                                                                                                                                                                   |                        |            |
| 3.5.  | Both entries are protected by bollards, preventing vehicle intrusion.                                                                                                                                                                                                                                        |                        |            |

| Item      | Topic                                                                                                                                                                                                                                                                                      | Who | Due Date |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 3.6.      | BO'R inquired whether the tenancy adjacent to the NW entry is sprinklered.                                                                                                                                                                                                                 |     |          |
| 3.7.      | AA confirmed that the tenancy is sprinklered, but the glazed shopfront does not achieve the prescribed level of fire separation.                                                                                                                                                           |     |          |
| 3.8.      | AA added that drencher systems are difficult to install due to limitations in the existing water supply.                                                                                                                                                                                   |     |          |
| 3.9.      | BO'R asked for the source temperature used in the radiant heat flux assessment.                                                                                                                                                                                                            |     |          |
| 3.10.     | AA responded: 830°C.                                                                                                                                                                                                                                                                       |     |          |
| 3.11.     | BO'R expressed no objection to the proposed method but recommended considering fire involving the largest vehicle that may be present in the area, such as a delivery truck.                                                                                                               |     |          |
| 3.12.     | AA clarified that the loading area is not adjacent to NW or North entries, but a people mover may be parked there. Thus, the assessment will consider this type of vehicle.                                                                                                                |     |          |
| 3.13.     | BO'R had no further comments.                                                                                                                                                                                                                                                              |     |          |
| <b>4.</b> | <b>JB-HiFi and Timezone – After-Hours Make-Up Air</b>                                                                                                                                                                                                                                      |     |          |
| 4.1.      | AA noted that Timezone and JB Hi-Fi after-hours are provided with make-up air to their smoke exhaust systems through the roller shutters. The make-up air velocity is increased up to 3.5 m/s, which exceeds the BCA DtS compliant 2.5 m/s.                                                |     |          |
| 4.2.      | Proposed Solution: Use CFD modelling to demonstrate that this increased airflow will not pose a hazard.                                                                                                                                                                                    |     |          |
| 4.3.      | BO'R asked if these tenancies are equipped with smoke exhaust systems.                                                                                                                                                                                                                     |     |          |
| 4.4.      | AA responded: <ul style="list-style-type: none"> <li>Timezone: Complies with Deemed-to-Satisfy (DtS) smoke exhaust provisions.</li> <li>JB Hi-Fi: Design still in development. If the selling floor area &gt; 1,000 m<sup>2</sup>, a DtS smoke exhaust system will be provided.</li> </ul> |     |          |
| 4.5.      | AA added that CFD modelling for similar projects showed that air velocity 0.5 m from the roller shutter drops to around 2 m/s.                                                                                                                                                             |     |          |
| 4.6.      | BO'R had no objections to the proposed solution.                                                                                                                                                                                                                                           |     |          |
| <b>5.</b> | <b>Plant Rooms – MSSB and Air Handling Units</b>                                                                                                                                                                                                                                           |     |          |
| 5.1.      | AA explained that air handling units (AHUs) located in the plant rooms are used to supply air to the smoke exhaust system and cannot be fire-stopped.                                                                                                                                      |     |          |
| 5.2.      | Proposed Solution: Use CFD modelling to demonstrate that the loss of two plant rooms is still within acceptable limits.                                                                                                                                                                    |     |          |
| 5.3.      | BO'R had no objections.                                                                                                                                                                                                                                                                    |     |          |
| <b>6.</b> | <b>Fire Hose Coverage</b>                                                                                                                                                                                                                                                                  |     |          |
| 6.1.      | AA continued that fire hose coverage for the Myer Mall and Plaza is provided via three lengths of hose from external hydrants that are located 50 m from the building with some hydrants located up to 100 m from the building and 2 lengths of hose from internal hydrants.               |     |          |

| Item | Topic                                                                                                                                                                                                                                           | Who | Due Date |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------|
| 6.2. | Some of the external hydrants are located under the covered area in the open deck carpark                                                                                                                                                       |     |          |
| 6.3. | GF is provided with 1 internal hydrant. 1F is provided with approximately 8 internal hydrants.                                                                                                                                                  |     |          |
| 6.4. | The latest standard requires internal hydrants to be within 4 m of non-fire-isolated exits. This project does not comply with that requirement. Instead, hydrants are positioned to ensure adequate coverage, with typical spacing around 25 m. |     |          |
| 6.5. | BO'R commented that DFES prefers hydrants on both sides of retail malls and recommends using 2 hose lengths only for deeper tenancies.                                                                                                          |     |          |
| 6.6. | BO'R suggested adding 1–2 additional internal hydrants on the first floor.                                                                                                                                                                      |     |          |
| 6.7. | AA acknowledged the feedback and will consult with Fire Safety about potentially adding another hydrant to the first-floor corridor.                                                                                                            |     |          |
| 7.   | <b>Submission Process</b>                                                                                                                                                                                                                       |     |          |
| 7.1. | AA asked how to proceed with the submission of the revised FEB.                                                                                                                                                                                 |     |          |
| 7.2. | BO'R advised to submit the revised FEB via email, with a note stating that DFES has not yet provided comments on the original FEB.                                                                                                              |     |          |

**Next Meeting:** N/A

**Location:**

**Chair:** Alex Alexandrovski **Title:** Senior Fire Engineer

**PREPARED BY:** Amy Chao

**DISTRIBUTION:** All present